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NOTES ON HEALTH:

HOW TO PRESERVE OR REGAIN IT.

BY

W. T. COLEMAN, M.D.

"I wish a little more were thought of the effect of the body on the mind."—
Florence Nightingale.

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NOTES ON HEALTH:

SHOWING

HOW TO PRESERVE OR REGAIN IT,

BY DIET, REGIMEN, &c.

WITH

A FAMILIAR EXPLANATION OF THE CHIEF FUNCTIONS OF THE HUMAN BODY, AND THEIR RELATION TO THE MIND.

BY

W. T. COLEMAN, M.D.

"I wish a little more were thought of the effect of the Body on the Mind."—FLORENCE NIGHTINGALE.

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1860.

TO THE MEMORY OF

A Lamented Friend, Benefactor, & Teacher,

WILLIAM PULTENEY ALISON, M.D., F.R.S.E.

ETC. ETC. ETC.

LATE PROFESSOR OF MEDICINE IN THE UNIVERSITY OF EDINBURGH,

Whose Eulogy is found

IN THE ADMIRATION AND REGRETS OF GRATEFUL PUPILS

IN ALL PARTS OF THE GLOBE,

AND THE NO LESS LOVING RESPECT AND ATTACHMENT OF THE NUMEROUS POOR—
EVER THE SPECIAL OBJECT OF HIS BOUNTY AND SKILL—

THIS ATTEMPT TO DIFFUSE THE KNOWLEDGE

HE SO ABLY TAUGHT,

IS REVERENTLY INSCRIBED

BY

THE AUTHOR.

PREFACE.

This little work is intended for the use of those who wish to regulate themselves in obedience to the laws of health, and to realize the many benefits—moral, intellectual, and physical—which attend such a course.

It is also addressed very especially to those who, having charge of others (particularly the young), wish to do their duty to them in this respect by training them to the same obedience.

The aim is to impart such information to general readers as may enable them not only to preserve their health when left to their own guidance, but, in time of inevitable sickness, to co-operate intelligently and effectually with their medical advisers, instead of giving ear to the delusive promises of quackery, or rendering the physician's efforts of no avail by errors in regimen, or want of self-discipline. Both these evils are owing, in some cases, to mere want of thought, but still more often to the want of that information which is the necessary food of thought.

It is hoped that these pages may do something to supply the need.

We may add, that, beside the practical object we have just spoken of, we have endeavoured to give a plain and untechnical account of the animal economy, such as may satisfy the inquiries of the general student who wishes to understand something of the science of life, without entering into details of anatomy and chemistry.

To know what can be known of our own frame, and the vital processes going on within and about us, must be the desire of all who use the power of thought with which we are endowed. The subject would be attractive were it no more than an intellectual exercise; but, beside being this, it is knowledge, on the wise use of which our moral and physical well-being depend.

10, New Cavendish Street, Portland Place,
July, 1860.

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CHAPTER I.

INTRODUCTORY.

Objects of the work—Necessity of understanding the laws of health—Use of such knowledge to the healthy and the sick—The body, with its many members, analogous to a well-ordered city or state—Material of the body—The cell its elementary form—Description of cells: vegetable and animal—Their points of likeness and difference—Chemical elements defined and explained—Organic compounds — Chemical constitution of the body — What chemistry can and cannot do for us in the choice and combination of food.

EVERY one who is experienced in medicine will have felt that, while the science of the physician must necessarily be guided by good sense, in order to heal his patient, a certain amount of good sense (as well as faith) is required in the patient, that he may *be healed.* Indeed, there are not a few cases where so much depends on the patient—so much on the daily, hourly observance of diet, regimen, and domestic management (including that chief thing of all, *moral* influence)—so much on the wisdom and tact of the patient and his friends—that it is certain all the efforts of the physician must fail, if not seconded by the intelligent endeavours of those with whom he has to do.

It may be safely asserted that, while this intelligent

co-operation is indispensable in some cases, it is important in all; and that of two persons affected with the same illness, and placed in the same circumstances, *that one* will always have the best chance of recovery who can, by himself or his friends, afford to his physician the most of this concurrent aid.

That he may do this, however, it is needful he should have a general knowledge of the functions of the human body, and of the laws by which its health is maintained and governed. Now, if this kind of information is needful in time of sickness, when he has only to second the efforts of his medical adviser, it is doubly needful for the prevention of disorder, and the preservation of health, for then, of course, he has no medical guidance, but is left to take care of himself, which he may well do when he has this knowledge, but can scarcely do without it.

How often might a serious attack of illness have been avoided by a little information of this kind? Even life is sacrificed for the want of it, in some instances; I mean that life is *evidently* destroyed by some flagrant violation of natural laws; for, as to the instances in which life is destroyed by quiet unobserved neglect of sanitary conditions, *they* must be counted by thousands.

The following account of the chief functions of the human body, and of the means which we have to adopt to preserve their efficiency, I have endeavoured to express in the plainest possible language; and if used as it is intended to be, it will not lead my reader to despise the physician's aid when he needs it. He will not need this aid so often, since he will be able to preserve health more effectually; but when it is required, the medical

adviser will find in his patient's intelligence his best help, instead of that hindrance he too often encounters in the uninformed.

In the present age, practical utility is everything, and I hope we have said enough to prove the claim of our subject to this advantage—if life and health are worth preserving,—but the thoughtful reader will surely feel some interest in regarding the laws of his own nature in another aspect.

The mechanism of a steam-engine is thought worthy of the study and admiration of educated men, who have no direct concern in its applications. They trace the hand of skill in its construction, admire and praise it.

But what are the wonders of the most intricate machinery, compared with those of a living man? Apart from life, even as a machine, he would be wonderful; but he "lives, he moves, and has his being in God." To that God alone can the deep mystery of his life be perfectly known. There is, indeed, in man something of the *infinite*, yet the faculties by which he can contemplate himself are but *finite*. We can, therefore, know even ourselves but in part, and this partial view we obtain only by *reflected* light.

Just as we see our natural face only by reflection in a mirror, so, to understand anything of ourselves, we must "hold the mirror up to nature;" and it is often in a figure or allegory that we obtain the most lively conception of what we are.

The human body, with its many members, its well compacted joints, its varied offices and parts, mutually inter-dependent, has been ever the standing type of a body politic, such as it should be. Let us for a moment

reverse the application, and making our well-ordered city* the type, look at ourselves under this figure. Beginning with the seat of government, the head: here we find, as in a secure palace, the sovereign mind enthroned; the will, the highest executive authority, ordering and controlling every action. Around are waiting the several ministers, the senses, whose office it is to report continually all that concerns the weal of the state. To this centre of intelligence information is conveyed, and from it commands issued to the most distant points, and this is effected by a system of *telegraphic lines*—these are the *nerves*, distributed to every part of the frame, and all connected either directly or indirectly with the brain. If a wire be divided at any point, telegraphic communication is cut off; the same result takes place if the galvanic machine at the centre is out of order. So it is in the body; a nerve divided, or a disorder in the brain, will alike produce paralysis.

Here, also, in this seat of government are the law courts, where the pleadings are carried on for the true and the false side. Reason and passion urge their claims with the zeal of the well-paid advocate, while judgment and conscience are our jury and our judge.

In a great city we require our *ventilators*, which we have to a certain extent in our parks, squares, and all open spaces: these answer to the lungs of the human body; but as in our city we need *more lung*, so in the human frame we often need *more exercise* of the lungs we have; for the office in both cases is the same—it is the double one of carrying off into space what is needful

* We assume here, for the occasion, our *city* to be what *our own* city is not, a civic polity and a *state* united.

to be expelled from our system, and of introducing a chief element of *vitality*, through the agency of pure air.

To our city we convey from every quarter supplies both liquid and solid; and our streets, with their constantly-rolling traffic and water-pipes combined, form no inapt representation of our lacteal vessels, veins, and arteries, by which the necessary materials are conveyed to and fro in the circulation, and as it were "*laid on*" or brought to our door in every remote corner.

If our supplies fall short of our waste we begin to feel the effects of famine, and if they much exceed it, a *glut* is the very unpleasant consequence, both to the natural and civic body.

An admirable system of drainage we have in our human frame: it is as the case requires, a double system, one by the *skin*, in which it is computed "twenty-eight miles of drain pipes" are laid (so numerous are these, though each is short), and another through well-known channels, carrying useless matters away in the most convenient, that is the lowest direction. Such a system of drainage we want, but have not, in our great city; yet we are now likely to have it, seeing that at length we have adopted the very plan which the analogy of nature pointed out to us.

The combined force and skill, the exercise of power guided by intelligence, which we have in our *workers*, whether of high or low class, are represented by the *hands*, which, guided by the intelligence of the brain, are the executors of power. While our *feet*, which carry us from place to place on missions of utility, have their counterpart in the *commerce*, with its organized loco-

motion, which *in* our city runs to and fro, and *from* our city carries us to the ends of the earth, to lay them under contribution to our enterprise.

Under this figure, then, we have a glimpse of the human economy in one of its many aspects; but, dropping the figure, let us for a moment regard it in another view. The material of our body may be considered in its elementary form and structure, and in its intimate composition. A brief outline of each, and a few simple definitions of the terms which will be employed in the following pages are all that this Introduction requires.

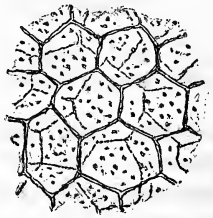
Some of my readers may have seen a wasps' nest,—it would be worth their while, at least, to take the first opportunity of doing so, as it would well repay any trouble they might take in procuring one. Meantime we have all seen a honeycomb, or part of one. We see that it is made up of *cells*. Now, this is no accidental or exceptional case,* for it is a received doctrine

* We have mentioned the *cells* of the honey-bee in this place, not only because they are the most familiar example of the cell *form*, and visible by the unassisted eye, but also to remind our readers that while we admire in their construction the power of *instinct*, there is an *unseen power*, which, even in the *vegetable* cell, moulds unconscious matter into a similar form, and adds this further capability of reproducing from itself other similar cells. Thus one cell may (under certain required conditions), *multiply* itself, as it were, until the whole structure is complete. A thin slice of almost any ordinary vegetable (a radish), will afford an example of these *cells*, which may be seen distinctly by the help of the *lens*, their diameter varying from the 500th to the 10,000th part of an inch. And as to the material, *proteine* (and for the meaning of which we may refer to page 21), of which cell-substance is composed, some writers have attributed to it not only contractility, but *sensibility*. The latest and best authority on this subject,

that this *cell-form* is to the human body what the square stone or brick is to the building; the tissues of the body being for the most part made up of separate cells laid together.

A cell consists of these three distinct parts, a membrane, within which is a nucleus, or small body, and within that generally another still smaller body (nucleolus) as in the annexed figures.

Such is a cell, and it is found that not only the tissues of animals, but of plants, are made up almost entirely of these elementary cells.



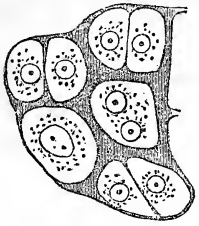
Vegetable Cells.

And as with the stone or brick of the same form, the various parts of a building are constructed of various forms, arches turned, columns and pilasters of various orders raised, so it is with the cells, which may be variously arranged and combined. But there is this difference between the cell and the stone, that the former is both plastic and vital, and can modify its form either by pressure, or by removal of some of its parts.

By pressure the circular becomes hexagonal, and the intervals may be filled up by unformed matter; by pressure, too, the oval may become more and more elongated, and so become mere fibres; and then, if laid end to end

makes this distinction between vegetable and animal cells: the walls of the vegetable cell do *not contain nitrogen* as an element, although *their contents* do; but in the animal cell, *every part* essential to the cell is nitrogenous.—Virchow, "Cellular Pathologie."

and in different planes, and the one side removed by absorption, even hollow tubes with solid sides might be obviously formed, thus; and all this appears actually to take place both in animal and vegetable tissues. So much for the *form* of our material structure. And now we come to consider it in a light no less interesting—its intimate or chemical composition. If any reader conversant with chemistry should take up these pages, he will read with patience, I hope, such very simple information as I shall here impart for the convenience of those who are not so conversant, or he may pass it over altogether.



Animal Cells—showing one mode of increase, by division.

All known material substances are distinguished by the chemist into two great classes. 1st. The simple or elementary, or those objects which cannot be divided into two or more substances by any known process. 2nd. The compound, those which are made up of two or more substances, into which they may be resolved.

The simple elements are, in round numbers, about sixty; but of these only about fourteen are generally distributed; the others are either rare or in small quantities. We shall require, however, for our purpose in this volume, to regard scarcely more than one half of these. The substances which we shall speak of chiefly are—

Carbon,
Hydrogen,
Oxygen. } These three elements form the basis of all vegetable substances.

Carbon, Hydrogen, Oxygen, Nitrogen.	These four are found in some part of every animal and every vegetable, but not in every part or product of these.

The distinction here made is easily explained; for instance, all the *lean* flesh of animals contains *nitrogen*, but animal *oil* or animal *fat* does not contain this element. Again—

The juices which might be expressed from the fresh leaf of the sago palm contain nitrogen, but the food known as sago, which is the product of this palm, contains none.

To the elements above alluded to add the combustible matters phosphorus and sulphur, which are almost universally found both in plants and animals. The well-known metal, iron, equally diffused, and potassium, sodium, and chlorine, the former the basis of potash, abundant in all vegetables; the two last forming, when united, common salt—chloride of sodium. The air we breathe is formed of two of the elements named above in the *gaseous* state, viz., nitrogen and oxygen.

Now, these are all the elements really requiring the reader's attention in the following simple statements; and these can be combined in various ways and proportions, though they are by the chemist known to be not random, but *definite* proportions.

There remains but one distinction to impress on the mind, and of this it is important to form a correct idea. That is, that two substances may have the same exact chemical constitution, and yet have different properties; or rather, they may have the same proportions of elements, so far as we can ascertain, and yet be of different

properties. This is supposed to depend on a different *arrangement* of their atoms, just as in numbers and in music.

3	8	5	3	The numbers are the same in each column,
5	5	3	8	the sum of them is the same, yet no two
8	3	8	5	columns are alike.

This distinction, as we shall see in the course of our inquiry, is of the first practical importance. A difference of *organic form* is often the sole reason why one aliment may be nourishing and another not so; the proportions of chemical elements in the two being nearly, or even quite, the same.

We have to form to ourselves a clear conception of what chemistry can and what it cannot do for us, in the matter of food, for instance.

Chemistry can exactly analyze our food, and thence infer what relation it bears to the tissues whose waste it is to supply. It can tell us just how much it contains of carbon, oxygen, nitrogen, and hydrogen, how much sulphur and phosphoric acid, &c.; but by putting all these together it cannot make an atom of food. It can explain, but cannot create.* Plants alone have this power—out of dead inorganic matter from the mineral† world to

* The chemist has indeed succeeded in constructing some organic compounds, but not such as are required to build up the fabric of the body. He cannot *make* fibrine, albumen, &c.

† It does not necessarily follow that the whole food of plants is mineral. Verdeil and Riolet (quoted by Mr. Lewes) say "that all *fertile* soils contain a soluble organic substance, resulting from decomposed *vegetable* matter." That plants depend much on conditions influenced by the presence or absence of certain mineral elements is certain; as, for instance, in the case of those which will

make those organic compounds which are fitted to nourish an animal body. "All flesh is grass," and is nourished by it; but man cannot, with all his science, make a single blade.

Organic compounds, as they exist naturally in the vegetable world, are alone capable of nourishing the animal frame, and the most exact imitation of these, by uniting their chemical elements into an artificial compound, would have no nutritive power whatever.

This small amount of preliminary knowledge might enable the reader to accompany us easily in the practical inquiry which is our chief object; but we will so far anticipate the subject of the composition of the animal body, compared with the productions of the vegetable world (which we shall consider more fully in the body of our work), as to mention here the chief of the *organic compounds* with which we shall be concerned; these are—

Albumen—consisting of the four elements alluded to above—

Carbon	56	parts
Oxygen	22	„
Nitrogen	16	„
Hydrogen	7	„
	100	

to which a little *phosphorus* and more *sulphur* are added.

only flourish where they are within reach of *saline* particles derived from the sea. One fact of this kind, not generally known, I mention on the authority of my friend Dr. George Bennett: that the fruit of the orange nowhere reaches perfection, *beyond a range of about thirty miles from the sea.*

Fibrine—the same four elements, with a little phosphorus and an equal amount of sulphur.

Casein—the same four elements, with a little sulphur *only*.

Now, all these three compounds are found in animal bodies, and they are likewise found with the same essential constitution ready prepared in the vegetable kingdom, but nothing resembling them is to be found in the inorganic or *mineral* kingdom; nor, as we have said, can the utmost art of chemistry produce one of them.

CHAPTER II.

GENERAL DEBILITY.

Signs of in the nervous system—Signs of in the muscular organs—Its usual cause, when unaccompanied by organic disease, is defective quality of blood—This in turn arising from defective nutrition.

Among the large sum of human complaints, daily do we meet with the following:—How is it I have so little strength? I do nothing that I am aware of to weaken me, yet I *am* weak, and know not why. Moreover, the eminent Doctor Blank assures me I have no organic disease. Then why can I bear so little exertion without fatigue? It is true I am not alone in this misfortune, for I know too many who make just the same complaint.

Is this, however—(and the complaint will at once suggest the inquiry),—an inevitable evil? or is it possible

to understand the nature of the defect, and to find its remedy? To this very natural inquiry the following pages propose to furnish an answer; but the attention of the reader is requested to a few preliminary considerations, which are needful for a clear understanding of the conditions of the question.

It may be observed, first, that the very terms, weakness and strength, must be taken in a qualified sense, in order to express the differences we actually meet with in our every-day experience.

For instance, if among a number of persons agreeing in the *general* complaint of weakness above described, we would hear from each the details of his or her case, we should find at least this difference—that some would especially lament their inability to endure a reasonable amount of *muscular exertion*—as walking, riding, &c.; others would complain of the exhaustion which so easily and rapidly follows any *excitement*; for example, a protracted evening party, of which music, conversation, a long chess game, might form the most arduous undertakings. To the bad walkers mentioned above, or at least *some* of them (for not a few are subjects of *both* kinds of debility), these merely exciting occupations would be more tolerable.

While, on the other hand, the young lady who could not endure a game of chess, might bear an unexpected amount of mere muscular action.* There is a reason for

* I have in my mind a remarkable instance of this distinction, in a lady who, after a well-fought chess battle — especially if it ended in the discomfiture of her skill,—would exhibit all the symptoms of exhausted nervous power, with a distressing inability to sleep. Yet she could walk both fast and far, with no sign of fatigue, so long as her *mind* was undisturbed.

this distinction, which will be explained at a future page. For the present, we only call attention to its reality, although we think it is a distinction; in proof of which most persons could adduce instances from among their circle of acquaintance.

So much for the *two kinds* of weakness which we may distinguish; and now, it must be remembered, that *original endowments* differ. We are not all born with equal strength, or power of endurance (still remembering the two kinds of strength, nervous and muscular); one person being so constituted as to endure much brain-work, another fitted for those pursuits which require the strong arm; and in each of these classes there will be found, every degree of original endowment.

A certain amount of natural strength being thus given, we can do no more than favour its full development by our faithful observance of the laws of health. We cannot outrun the gift of God, but may use the talent to the extent to which it is given, and so acquire more by usury; or we may neglect or dissipate that with which we are entrusted, whether it be little or much. Moreover, the results of this neglect or improvement (it is in the physical as in the moral world) are transmissible, and science has well established the fact that even *acquired* physical conditions, whether for better or for worse, are reproduced in our offspring, and in more senses than one the sins of the father are visited on the children, and the blessing pronounced on the right may extend to uncounted generations.

Parents have here something to think of. The art of medicine, however, is concerned to promote the *greatest possible power*, the maximum of healthy development in

man, although this can only be done within the limit of that capability with which each individual was endowed at his birth.

When we consider, therefore, the causes of debility (apart from organic disease), although we must reckon as one among them congenital defect, in the case of those who exhibit strength below the average, even from birth, we are practically concerned with this as marking merely the limit of our most successful efforts; we cannot expect to reverse the order of nature—to make him strong who was in his birth made weak. But much can be done; instances can be cited where very much *has* been done to supplement the defect of nature, as it were, and these remarkable examples are pregnant both with instruction and encouragement;—encouragement especially to those who are conscious of some natural defect.

This term itself is of course comparative. Perhaps in the present luxurious and artificial state of society there are few who come up to the highest standard of health, even at their birth; but we should apply the term natural or original defect only to those who fall below the average in this respect.

A word may be addressed to the general reader as to the meaning of the expression *debility without organic disease.*

This does not mean that every organ of the body performs its function perfectly in this state of debility—this is rarely the case; but that there are none of those tangible defined changes of structure in any particular organ or organs; and then, speaking conventionally, we say there is no organic disease. The patient may be

assured on the strength of stethoscopic examination that his lungs and his heart are sound; and the doctor who delights in liver theories may be unable to make a liver case of our patient who still complains of weakness. Where then is the defect, and what is it?

Now, if it be remembered that all organs of the body whatsoever are dependent for their supply of material and power on the one vital fluid, the blood, it is easy enough to see that if this blood be either defective or materially altered from the healthy standard, general debility must ensue.

And this defective or altered condition of the blood is in fact the immediate cause of general debility, in the great majority of such cases—not in all, certainly, and this will at once appear if we reflect that any hindrance to the free supply of blood to *any* organ or part of the human body must in the same degree render its functions defective.

The deficiency of supply producing the same, or a more decisive result, than the defective *quality* of the blood.

For instance, we may see even a strong man, whose blood is in excellent condition, suddenly lose consciousness and fall to the ground, on witnessing some horrible scene, or on hearing suddenly some fearful intelligence.

The explanation of this is, that the emotion acting on the nerves which control the heart, induces a temporary disturbance or suspension of its action,—the blood is no longer supplied to the brain with its usual regularity; the function of the brain is suspended. This is the way a *faint* or fainting-fit, as it is called, occurs.

But habitual debility, in most cases, depends rather on

the altered quality than the imperfect supply of the blood to any particular organ.

It does not, however, follow that, although the changed condition of the blood be the most prominent feature of such cases, it is the first link in the chain of causes. Far from this: the blood is the life of every organ, and this being defective, the function of every organ *languishes*, as it were. But whence arises this condition of the blood? This question carries us back to the origin of the blood supply itself.

The blood (which supplies the waste of every part, from the delicate and mysterious organism of the brain to the hard bone and tough sinew) is itself fed with fresh material by means of the digestive organs. *They* first receive the material from the outer world which is destined to be built up into the living temple of our body; it is their office to elaborate them, to prepare them for admixture with the blood; and this process is perfected by that rapid revolution through the lungs which each portion of fresh blood undergoes before it enters the general circulation which is to feed the whole frame.

We see, then, that the most probable source of defective blood would be either—1st, a defect in the quality or quantity of its material, food; or, 2nd, a defect in the function of one or more of the organs whose office it is to convert and apply the food to the purpose of nutrition. Before, however, we proceed to consider these defects in the quality of the blood, we must give an outline of the blood itself in the healthy state, and this will be the subject of the next chapter.

CHAPTER III.

THE BLOOD.

Its importance to *all* the functions—Its good quality essential to health—Its quantity—Its constituents—Red corpuscles: their use and importance—Chemical composition of blood and that of flesh.

Respecting the *quantity* of the blood, and the proportion it bears to the weight of the body, little need be said.

It is usually estimated at one-fifth of the whole, but we have scarcely any practical concern with this matter, since almost all the ailments formerly attributed to too much or too little blood are now, with much better reason, ascribed to *changes in its quality*.

The following is an outline, sufficient for the general reader, of the composition of the blood, in health:—

While still circulating in the living body, it consists of an almost transparent colourless liquid, in which small bodies may be seen floating and moving with the current of the blood. Most of these bodies, or corpuscles, are red, and they give the blood its peculiar hue; but some of them are white, or colourless. If we would compare the blood of man with that of the lower animals, we find that, as we descend in the scale of creation, the proportion of the red to the white corpuscles continually diminishes, until, in the lowest animals, the *red* are found wanting entirely

From this it will be easily concluded that the red corpuscles are the most important, and we shall dwell on these only for a minute.

As to shape and size, they are *flattened discs*, not much unlike a halfpenny in form, and some notion of their size may be formed, when we find that 800 or 900 might be placed side by side thus, within the space of about a quarter of an inch.

Blood discs (magnified).

Dr. Rees,* one of the best authorities on this subject, describes the corpuscles "as made up of three constituents, viz., an envelope, a nucleus,† and a red colouring matter, enclosed by this envelope or sac."

With regard to this colouring matter, the most important point is that in *healthy* human blood, it is always associated with iron. It does not follow that the colour is entirely produced by the iron, but it is beyond doubt that both a due supply of these red corpuscles, and the combination of iron with them, is most essential to the functions of active life.

Dr. Carpenter‡ observes, "It seems highly probable that they have, as their principal office, the introduction of oxygen into the blood that circulates through the *capillaries*,§ and the removal of the carbonic acid set

* See his "Gulstonian Lectures" for 1845.

† By the majority of observers, the existence of this nucleus in the blood of adult *man* is denied, although it is evident enough in the blood of the lower animals, as also in the human embryo.

‡ "Principles of Human Physiology," § 150.

§ The *smallest* blood-vessels are so called from the Latin "capillus" (*hair*).

free there; serving, in fact, as the medium for bringing the tissues into relation with the air, the influence of which is necessary for the maintenance of their vital activity.

"The red corpuscles are most abundant in those classes of animals which maintain the highest temperature.

"We find that the influence of oxygen upon the nervous and muscular systems is essential to their vital activity, and it seems to be by their agency, in bringing these into relation, that the red corpuscles possess that intimate connection with the animal functions, which we find them to possess. The animals whose temperature is the highest are also those whose senses are most acute, and whose movements are most energetic; whilst, on the other hand, if there be any unusual diminution in the proportion of red corpuscles, it is invariably accompanied by *muscular debility, and deficient nervous power.*"

Need we, then, be surprised, when the pale cheek, the lip no longer "ruddier than the cherry," but fading gradually from a dull pink to white, indicate too plainly the want of red corpuscles in the blood, that there should be complaints of *muscular* debility, or want of "*nervous* power."

To enter fully into the details of the chemical composition of the blood would be tedious and unprofitable to the general reader. Regarding its circulation and the changes effected in it by the process of respiration, so much as is needful for understanding the rules of health will be stated at a future page.

At present we are concerned only to compare its chemical constitution with that of food. It will be

necessary, therefore, in order that the reader may understand the subject of diet, and especially those rational grounds on which the choice of vegetable diet depends, to give in this place a short exposition of the chemical composition of the blood, and that of the human body generally.

The relation of these to the various articles of food will then be clearly seen, and no intelligent reader will fail to be convinced that the right choice of diet is really and literally a *vital* matter; for, be it observed that the debility, which is the chief subject of our consideration, and for which we seek to lay down remedial rules, is but a first indication of nature's decay and dissolution. In short, debility unremedied and ever increasing, as it must do under mistaken treatment, tends but to death.

In common parlance, "flesh and blood" are spoken of as making up man's corporeal nature; and, in strict truth, the constitution of flesh is held by the chemist to be identical with that of blood. Both consist chiefly of the following four elements, and, according to Mulder, in these proportions:—

Carbon	55·	parts
Hydrogen	7·2	,,
Nitrogen.....	14·5	,,
Oxygen	23·3	,,
	100	

This is the composition of what has been called *proteine.** It has been so called because it is held to be

* From the Greek πρωτος (first).

the *first* form which those elements assume in the vegetable kingdom which ultimately form flesh or blood. It is the general basis of both.

From this primary form are derived three secondary forms, or organized compounds, named albumen, fibrine, and caseine.

Albumen is so called from the *whiteness* it usually assumes when coagulated, as in the familiar example of the boiled white of egg.

Fibrine, so called from its constituting the chief part of the fibre of muscles.

Caseine, from its being the basis of cheese—it is found in milk chiefly. The composition of albumen is that of the proteine given above, with the addition of sulphur and phosphorus; that of fibrine is nearly the same; but that of caseine differs in this, that it contains *no* phosphorus, but sulphur only.

Now each of these three substances is found with the same identical chemical composition, in the vegetable kingdom, although they differ slightly in form.

It is mentioned by Liebig, as an instance of the exact resemblance between animal and vegetable caseine, that cheese is, among the Chinese, actually prepared from the caseine contained in *pease*.

It seems to be the office of the vegetable kingdom to prepare and organize each of these substances, albumen, fibrine, and caseine, from the unorganized mineral kingdom. They are then fitted to become part of the living frame of animals.

It is not possible for any animal to perform this office, and to construct living organic compounds out of dead mineral matter. If the exact chemical elements enume-

rated above, with the due proportion of sulphur and phosphorus, were supplied to our stomachs, we should not be able to derive the least nourishment from them. These elements must be first organized for us by the vegetable world, and then we appropriate these organic compounds to our use either immediately when we live on vegetable food, or mediately when we use the flesh of the lower animals.

There is also another form of organized matter which enters largely into our frame, but which is *not* held to be a modification of *proteine;* on the contrary, it is found not to be convertible into any of its forms, nor to be capable, therefore, of supplying flesh and blood. This is *gelatine*, so named from its form, that familiarly known as *jelly* (*glue* being a coarser kind of it).

Gelatine was at one time supposed to have peculiar nourishing properties; it is now held to be of no use in renewing muscle or blood-particles; but that it *is* useful in some other way experience testifies, although there is much obscurity as to its mode of action. Now, it is a remarkable proof that the nutrition of the body is not a mere matter of chemical calculation, that gelatine differs very little in this respect of chemical constitution from the other organic compounds. It has, like them, carbon, hydrogen, oxygen, and nitrogen, in nearly the same proportions, and its *nitrogen* is indeed in excess of theirs. Yet it is not fitted to produce flesh and blood. It seems to serve a mechanical office, as it were, in the animal economy, and to be endowed with lower vital power. The bones require a large share of it; it constitutes the glue or cement which holds together the earthy matter of bone, chiefly consisting of phosphate of lime. Among the elements which

are found in the human body, beside the lime, or rather its basis, *calcium*, which we have just before mentioned as entering largely into bone, and beside the sulphur and phosphorus which enter into fibrine and albumen (also the *former* into caseine), the following minerals are found:—*silicon*, the basis of flint; *chlorine*, the active part of common salt; *fluorine*, *potassium*, and *sodium*, the bases respectively of potash and soda, and the following metals: *iron*, *manganese* (perhaps *aluminium*), and *copper*.

Of these, iron and phosphorus seem especially important.

The combination of *iron* with the red particles of the blood has been already mentioned, and Liebig doubts if their function, that of feeding the various organs and parts of the body, before described, does not *essentially* depend on this combination.

The importance of *phosphorus* is evident from the significant fact that it is an especial characteristic of the substance of the *brain*, the seat of thought; so that a deficient supply of this ingredient might be expected to tell greatly on the activity of this organ, that is, to limit greatly our powers of mental exertion.

It is true that phosphorus, as such, is not found in the animal body, nor in vegetables; it exists only as phosphoric acid, in the vegetable kingdom usually combined with potash,—and in the animal combined with lime, as in phosphate of lime of bones, with soda, in the blood, and with fat, as in the substance of the brain.

CHAPTER IV.

FOOD.

Its twofold purpose: to repair waste and to supply the material for producing heat—Both purposes connected with every vital process and every change of matter in the living body—Distinction of articles of food into two classes: the nitrogenous, or flesh-supplying; the non-nitrogenous, or heat-supplying—This theory of Liebig *not* to be accepted *absolutely*—His theory of animal heat requires certain modifications—Choice of animal food—Relative digestibility of different animal aliments—Choice of vegetable food—Comparative nutritive powers of different kinds—Comparative digestibility of each.

HAVING now before us a view of the composition of the animal frame, we are enabled to understand the adaptation of various articles of food to supply its wants.

It is, however, to be observed that food has a twofold purpose to serve, and it is necessary to distinguish these very clearly, because there are certain articles of food adapted to the first purpose and certain others adapted chiefly to the second.

A certain temperature of our bodies being requisite for health and comfort, it is needful that the animal heat produced, and subject to continual expenditure in various ways, should be maintained by continued supplies of *fuel*, so to speak.

The first purpose of food is, thus, to maintain animal heat, while the second is, to repair the actual waste of material going on in the hourly wear and tear. To

understand this second process it is necessary to observe that every exertion of the muscular organs is accompanied by a transformation and waste of tissue, some effete and useless portions being absorbed, and expelled through various channels, as the skin, the kidneys, &c.; and in this way the whole body is continually undergoing a change of particles, so that in a given period (not, however, exactly definable) the old components of our body have passed away and new ones have taken their place.

This is, then, the second purpose of food, viz., to supply this material waste, and also a surplus for growth during the early periods of life.

Even mental exertion, that is, the action of the brain, is accompanied by the same decomposition of tissue, involving a chemical change, and what is a most interesting and well-ascertained but too-little-thought-of fact, from every chemical change so effected a *development of electric power* necessarily ensues, so that we cannot either think or act without an electric change, for every thought and act implies motion, waste, and chemical change in the brain, or *some* nervous centre.

It is now an undisputed law, that chemical and electric change is reciprocal and inseparable.

The living human body is an example of a complicated and well-balanced electro-chemical machine, governed, however, and guided by that mysterious vital element which, like the algebraic x, enters as a constant but unknown quantity in all our problems.

This electro-chemical agency is unceasing; it is wherever life is, and in the blood, which is the life, it

plays no small part; yet the whole of this result has to be produced by the food, from which alone the blood is derived.

If the reader will refer to the statement of the composition of flesh and blood, he will see that *nitrogen* is one of its essential elements, and that, consequently, no article of food which does not contain nitrogen can possibly supply *all* the elements of flesh or blood.* Hence arises a necessary distinction of all food into two great classes,—1st, those containing nitrogen; 2nd, those in which nitrogen is wanting, that is, such as contain carbon, hydrogen, and oxygen only.

The articles of diet of the first class are, animal food of every kind (oil and fat excepted), and of the vegetable kingdom the following, which are stated in such an order as to show (nearly) the *proportion* of nitrogen which each contains, as compared with human milk.

* We beg the reader's attention to the stress laid on the word *all*, in this passage, as we might otherwise fall into the error of supposing that the division between the plastic and the heat-producing classes of food is *absolute*; as if the one containing no nitrogen could furnish none of the *other* elements of flesh—and this cannot be proved,—and as if the articles of the nitrogenous class could furnish no fuel—and this conclusion seems to be equally unfounded. If we believe with Lehmann and others, on the one hand, that *organic* matters *may* be constructed, as it were, in the vital laboratory, then the hydro-carbons may enter into new combinations, and *contribute* to the restoration of our tissues; while, if we think these hydro-carbons are not the *only* substances in our body capable of oxidation, and that even oxidation itself is but *one* of many processes by which heat is evolved, then we shall see that much *fuel* for the vital fire may be found in the nitrogenous class of food.

Supposing human milk to contain in any quantity ten parts of nitrogen, then

House-beans would yield	32	parts
Haricot beans	28	„
Mushrooms.....	28	„
Pease	23	„
Bread of *brown* meal.....	17	„
Bread of white flour	14	„
Oat cake.....	13	„
Barley cake	12	„
Turnip	10	„
Rice	8	„
Potatoes.....	8	„
Pears and apples (Berard's analysis)..... about	5	„

To the second class, or the heat-producing, and not containing nitrogen, belong the following :—

Oil and fat of every kind, whether of animal or vegetable origin.

All kinds of starch—arrow-root, sago, tapioca, &c., &c.

Sugar of every kind—whether grape, beet-root, maple, or cane.

This table, although it gives the relative amounts of nitrogenous food, must be considered only as a record of *chemical facts*, which has its great use, but its abuse also. It is no guide to the *absolute value* of aliments, and forms only *one* element in the complex considerations which must guide our *choice* of food.

Those of the first class have been called nutritive or

plastic, because they are convertible into the albumen or fibrine, which form the bases of flesh.*

Those of the second class have been termed respiratory, or heat-producing, because, by the act of respiration chiefly, according to the views of Liebig,† their carbon and hydrogen are, as it were, burned or oxidized. They are the fuel by which the vital fire is fed; and this must be kept incessantly burning, since the temperature of the medium in which we live—the atmospheric air, is usually below, and generally in our climate much below, the temperature of the healthy body. This is about 97° of Fahrenheit, the ordinary heat of the blood, and we know that the temperature of the air much more frequently falls below 60° than rises above it. The mean annual temperature, on an average of several years, has been stated at about 50° (for London), leaving a balance of 47° to be made up by the continual production of heat from within; and there is also the heat lost by radiation to be considered. We do all we can, of course, to lessen the task by the use of slow conductors of heat, as clothing; still, sufficient remains to be done to require a large supply of hydrogen and carbon in the shape of food, that we may keep pace with the demands of the air upon us, and prevent any destruction of the frame-work

* Gelatine is an exception, which, although it contains nitrogen, cannot, owing to the difference of its organic form, replace flesh and blood.

† We may observe (and at p. 30, and p. 31, the reasons for the opinion may be found), that most physiologists now conceive this oxidation to be accomplished only through the change of matter going on in all parts of our body, and that this is also not the *exclusive* source of animal heat.

itself, which, in the absence of sufficient fuel from without, would infallibly be used up and burned.

The case would be somewhat similar to that of a household shut up in a log-house in the inclement season in Canada, who, if cut off from a due supply of fuel in the ordinary way, would be compelled to use up some of the very timber of their dwelling, beginning, of course, with the least essential portions of the structure. So it would be with the human body, if deprived of its due supply of hydrogen and carbon in the shape of food. The whole of the fat of the body would be first used as fuel, as that which could be best spared in the animal economy, and as being also the best adapted to supply the want, since it consists of hydrogen and carbon almost entirely.*

* It may be interesting to the reader to learn the progress of opinion in the scientific world, respecting the origin of animal heat.

Lavoisier, an eminent French chemist (who perished by the guillotine in 1794), conceived that from the direct union of oxygen and carbon in the lungs themselves, heat was produced, and thence diffused over the whole body; but this idea was soon given up, as it was found that the lungs had not the high temperature, compared with other parts of the body, which, according to this theory, they should have had.

Liebig, the eminent German chemist yet living, still attributing the generation of heat to the oxidation of carbon, &c., holds that the actual union of the two elements takes place through the capillary system. This view has been very generally accepted, but the following eminent men of science have found objections to it:—Lehmann, Robin, Verdeil, and Dalton.

Dutrochet, a French philosopher, objects that this theory does not agree with the fact that in plants he found the maximum evolution of heat to be about the middle of the day, just when the absorption of carbonic acid and *exhalation of oxygen* are at their

There is one kind of aliment which comes strictly under the head of the second class, although it is generally used rather for its property of quickening the actions of the body than with the view of supplying it with materials. I allude to fermented liquors of all kinds, all containing alcohol, which is a hydro-carbon. It supplies no nitrogen, as it contains none, and in cases where it is inappropriately used, by diminishing the appetite for food of the first (or nitrogenous) class, it often indirectly diminishes the supply of this vital principle.

Hence its great injury when misapplied, for it affords heat instead of strength, and by stimulating the functions of life increases the rate of waste, while it lessens the supply of the only material which can supply that waste.

We shall speak more fully of this subject at a future

greatest activity. Oxidation of carbon then does not produce the heat in this instance, and the argument of analogy, from the vegetable world, is directly contradictory of Liebig's view.

Dr. Dalton ("Human Physiology," New York) brings forward other objections, and sums up his conclusions in the following words (page 228):—"Animal heat, then, is a phenomenon which results from the simultaneous activity of *many different processes* taking place in many different organs, and dependent on many different chemical changes in each one." This is perhaps not far from the truth, as at present ascertained; it would go to show that the oxidation of carbon, or other combustible substance, is not the only source of animal heat, and that (as in the case cited by Dutrochet in the vegetable world), it might be generated quite independently of the process of oxidation. Yet we cannot conceive it proved in any way, that in ordinary circumstances, this is not one of, if not *the* chief of its producing causes, in the state of health.

page; for the present we wish only to point out the mode of action of fermented liquors *considered as aliments*. We see that they only afford fuel. Their action as remedies in certain cases of disease, and their good or ill effects when judiciously applied, on the one hand, or misused on the other, must be quite separately considered.

The proportion which animal diet should bear to the vegetable is one which in health requires no defined rule, it may be safely left to the natural appetite and inclination. Mixture and variety are, within certain limits, necessary, and it is certain that the structure of the teeth, some being adapted for the division of vegetable food, some for the tearing of flesh, resembling those of the carnivorous or flesh-eating animals, some adapted for grinding, as in those animals who live much on grain and other seeds, denotes a mixed diet to be the proper food of man.

And experience abundantly confirms this idea, for, although some races of man are found who live on vegetable, and some on animal food, exclusively, yet it may be safely affirmed that the highest development of civilized man is attained under the use of a mixed diet.

Rice in the East, and potato in the West, form the basis of diet of some millions, and both (with adjuncts * to a small extent) are capable of sustaining life, since, as we may see in referring to the Table, p. 28,

* It is a mistake to suppose that the rice and potato-eating people eat nothing else, under *ordinary* circumstances;—when they *have* been compelled by unusual necessity to live on them *exclusively*, disease soon results.

both contain nitrogen, the element of flesh; but in both instances we find these races falling under the guidance or the domination (as the case may be) of the better-endowed man, whose diet is more complete. And it is evident that, in proportion as these races of men are raised to the standard of activity of the dominant race, they adopt their diet as well as their other habits. Even the Irish soldier, before whom the rice-eating Chinese or Sepoy was comparatively feeble, was no longer potato-fed, but enjoyed the rations of the British army. When the average amount of flesh meat is consumed, there is little more needed for the maintenance of health than very moderate additions of wholesome bread, succulent vegetables, and fruits: indeed, only extremely small quantities of these last-named articles of diet are absolutely required.

The case, however, is very different when either very insufficient supplies of meat, or none at all, can be taken. In this difficulty the choice of vegetable food is all-important. We have already said that the articles of the heat-producing, or second class, taken alone are no substitute at all for meat; the choice must be among those of the first class, or nitrogenous articles.

We see that beans and pease (and in general leguminous seeds) are more rich in nitrogen than even wheaten bread; and, as Dr. Carpenter* has observed, these "would therefore be more nutritious than wheaten flour, were it not for their deficiency in phosphate of lime."

It is scarcely needful to remind the intelligent reader, that when it is said that a certain amount of food belonging to the second class, or to the heat-producing group, is

* "Principles of Human Physiology," p. 491.

essential to the maintenance of our temperature, it is not meant that the needful amount of carbon and hydrogen must necessarily be taken from this class, and *not* from the other; for it will be perceived that class the first, or the plastic group, besides its nitrogen, contains also a large amount of the two elements required for the production of heat, namely, carbon and hydrogen.

A certain amount of carbon and hydrogen, then, being required for this purpose, it may be taken from both groups, or either; but the second class supplies *these elements only* without the nitrogen; the first class supplies these and the necessary nitrogen, moreover.

It follows that life (if not health) may be sustained by food of the first class alone, which supplies both reparative material *and* fuel; but by the second class *alone* life could not be sustained, because the essential element, nitrogen, would be wanting.

The reader may be inclined to ask, then, why we need at all to have recourse to the dietetic articles of the second class, since those of the first contain all we need. To this it may be replied, that these articles of food of the second class, although not sufficient to maintain life of themselves, are useful and convenient as auxiliaries, while they fulfil entirely one of the purposes of food, namely, the production of heat; and experience has shown that the more we extend the list of alimentary substances, so that we may vary it in almost endless combination, the more fully does it conduce to the maintenance of health.

For, notwithstanding that many single articles of diet of the first class, as flesh meat, for instance, contain *all* the elements required both for reparation and fuel; yet

it is found, by experiment, that health, and even life, fail if we are long restricted to one article.*

Milk is almost the only one on which it is found we can live exclusively for any lengthened period, and we know that nothing is so well suited to the earliest stage of human existence.

But, then (as Dr. Carpenter observes), "it is suited for the state of comparative passiveness in which the infant passes its early days;" and as this period is exchanged for one of greater activity, so does it become necessary not to withdraw the milk which is still needful, but to add other food better calculated to maintain the active functions.

The nutritive value of the food, then, it will be perceived, is *very far from being a question of chemistry alone.*

A mixture of diet, within certain limits, promotes digestion and assimilation, and it would seem that the mutual affinities and influences of such a variety of food, the properties of some correcting and qualifying those of others, are, if not essential to life, quite *indispensable* to health and vigour.

In cases, then, where either no flesh meat can be taken (and the animal broth, jellies, &c., may be included under this head, as they are mere preparations of flesh), or only an insufficient quantity, and where milk and cheese also

* Majendie, a French physician, fed animals on a single article of food, by way of experiment, and found that when this one article was selected from our second or non-nitrogenous class, they very quickly lost health, and ultimately life; but even when it was from the first class the food was selected, viz. that containing nitrogen, the result was the same, only requiring more time to produce the fatal issue.

disagree or are rejected, the proper substitutes would be —1st, bread (wheaten); 2nd, beans, pease, &c.; 3rd, the autumnal and summer fruits.

The most important of these is undoubtedly bread; for, although, as we see in Table, p. 28, beans and pease contain more nitrogen, they contain *no phosphorus*, the importance of which the reader is prepared to appreciate from what has been said already.

It is not without good chemical grounds that bread has been called the "staff of life," seeing that it contains a peculiar combination of the flesh-producing constituents with a due amount of starch, or heat-producing element.

It is, however, certain that much that is sold and eaten under the name of bread, more particularly in London and other large towns, is of a quality not calculated to sustain this high character of bread as a life-supporter.

The reasons for this are various.

1st. We see by our Table that the brown or undressed flour yields a higher proportion of nitrogen than white flour. Some of the best portion of the flour adheres closely to the inner surface of the bran, and is removed with it, so that after the bolting of flour, as it is termed, by the miller, the loss must be considerable.

2nd. There may be, and are undoubtedly, various articles mixed with flour, none of which, however useful they may be to the baker, can fail to lessen the wholesomeness and nutritive qualities of bread.

The usual additions are rice and potatoes. (Both, as we see by the Table, contain far less nitrogen than wheat flour.) Then alum always, and sometimes magnesia, ammonia, &c., are added.

Now, of these mixtures it may be said, that if they are ever useful to the bread-eater it must be by accident, for these are medicines, and not food; and when medicine is given in this indiscriminate way mixed with food, for once that it happens to do good, it must do harm a thousand times.

Even if it should be considered that these additions to the proper ingredients of bread are not of themselves deleterious (for so *little* alum, it may be said, *can* do no harm), it is by no means certain that they are not hurtful in another way, namely, by altering the chemical condition of the nutritious elements.

Indeed, it is highly probable that this is the case, for it is well known that even when the elements of certain articles of food yield the same, or nearly the same, result on chemical analysis, if the *form* under which they are combined differ, their dietetic powers are not the same.

For instance, the analysis of gelatine, as compared with albumen, is—

Gelatine (*in* 100 *parts*).		Albumen (*in* 100 *parts*).	
Carbon	50·05	Carbon.....	53·5
Hydrogen.....	6·47	Hydrogen	7·0
Nitrogen	18·35	Nitrogen.....	15·5
Oxygen	25·13	Oxygen	22·0

In both gelatine and albumen a little sulphur is found, and in both a minute proportion of some phosphoric compound, for, on burning, an ash is produced containing phosphate of lime.*

Now, it is ascertained beyond all doubt that gelatine

* See Griffith on the Blood, part ii. p. 16.

will not produce flesh and blood; it is no substitute for albumen in this office. The *chemical* difference between gelatine and albumen is indeed small; but the difference of *form* (which may be considered, in Liebig's words, as a "different *arrangement* of its elements") is very great. Yet such a difference in any alimentary substance *may entirely change or neutralize its dietetic power.*

So it may be with bread; and this view of the evil effects of chemical additions to bread has been, perhaps, too little attended to. We hear much of the direct effects of the *deleterious alum*, &c., and little of the *very probable* evil influence of that and other additions in *changing the condition or form* of the whole mass of bread. This is, at least, a very probable result of the adulteration of shop bread.

3rd. Another cause of the comparatively innutritious quality of the bread usually sold is probably its excessive fermentation. It is usually supposed that bread cannot be too light and spongy; indeed, the baker seems to consider such bread to be alone salable. Perhaps it is so; but it is a question how much fashion and how much reason may have to do with this. The advantages and disadvantages of a very light and porous bread must be looked at in two respects.

The first consideration is its digestibility; the second, its nutrient power when digested.

We may concede that to some stomachs the lighter bread proves most digestible; but experience proves that to many others, bread either little fermented (called domestically *close* bread), or entirely *un*fermented bread is found the most easy of digestion.

As to the second consideration—its nutritive power,—

we may observe, that the fermentation of flour has never been supposed to *add* anything to the nutritive power of flour; that is, that, weight for weight, unfermented bread or pudding made of simple flour and water could nourish *less* than highly-fermented bread. On the contrary, if we listen to the majority of chemists, we have positive proof that the nutritive quality of bread must be diminished by the process of fermentation.

Dr. Gregory, speaking of this process ("Organic Chemistry," article "Panification"), says, "The starch, in general, is little changed, but *the sugar disappears*, as well as a part of the *gluten and fibrine*." The inference is, that we lose much of that which is convertible into *vital fuel*, or into fat; and, what is more important still, we lose a part of the elements which go to form healthy blood, namely, the "gluten and fibrine."

Now, this loss in the nutritive power of wheaten flour is a mere result of the very process of fermentation itself. It is not dependent on any error in that process, or on any addition of deleterious ingredients.

But, besides this known and ascertained loss, it may be suspected, on good grounds, that the whole mass undergoes some modification which may lessen its capability of repairing the waste of the animal tissues.

On the other hand—for we must look at both sides of this question,—it is possible that some new product may arise from fermentation, which, if it does not add to the strictly reparative material, may yet be useful in some other respect.

Forsyth ("Dictionary of Diet") observes, that "Bread newly baked has a peculiar *odour* as well as *taste*, both of which are lost by keeping, showing that some peculiar

substance must have been formed during the operation, the nature of which is not understood." Now, this "peculiar substance," from its being "lost by keeping," is probably some volatile product, and possibly, to say nothing of the alcohol or spirit, which it is well known is produced by fermentation from the starch previously converted into sugar, on this may depend, perhaps, the cordial and exhilarating effect which every observant person must have noticed on eating freely of bread warm from the oven, especially good household bread in this state. We can speak with certainty of this effect from repeated experience; but the experiment is, of course, not to be recommended to all, as it is well known that to many persons warm bread proves very difficult of digestion.

In the opinion of most chemists, then, it seems that fermentation results in at least some loss of gluten,—the most nitrogenous and therefore the most nutrient element of flour. Dr. Pereira (see his treatise on Diet) admits, that "Although the gluten does not appear to have suffered *much* change in its amount, yet in some of its qualities, tenacity and elasticity, it has undergone considerable alteration." Can we be *sure* that this loss in quantity, and still greater change in quality, in that particular component of flour which distinguishes it from other farinaceous food, is not the cause of that defect in sustaining power which is found in very light (that is, much-fermented) bread?

We cannot, however, withhold from the reader the opinion of Liebig on this important subject. He says ("Letters on Chemistry," p. 460, 4th edit.):—"Many chemists are of opinion that the flour, by the fermenta-

tion in the dough, loses somewhat of its nutritious constituents from a decomposition of the gluten; and it has been proposed to render the dough porous without fermentation by means of substances which, when brought into contact, yield carbonic acid. But, on a closer investigation of the process, this view appears to have little foundation.

"When flour is made into dough with water, and allowed to stand in a gentle warmth, a change takes place in the gluten of the dough similar to that which occurs after the steeping of barley, in the commencement of germination in the seeds in the preparation of malt; and in consequence of this change the starch (the greater part of it in malting, in dough only a small percentage) is converted into sugar. A small portion of the gluten passes into the soluble state, in which it acquires the properties of albumen; but by this change it loses nothing whatever of its digestibility or of its nutritive value."

If we allow the single opinion of Liebig to be of equal weight with that of the "*many* chemists" he alludes to as of an opposite opinion, the question of the "nutritive value" of fermented as compared with unfermented bread, would seem to be still one to be decided by practical experience.

And this, I think we may say, is decidedly in favour of the unfermented bread; for it will be found that the classes of men who sustain the hardest labour with little flesh meat, all use either unfermented flour pudding, or bread which has been but little fermented.

Those who supply railway labourers and such workmen with bread, will tell you that unless it is very *close and*

compact (that is, little fermented) they are not satisfied, as they say "*they cannot work on light bread.*"

And this rule is always found, I believe, to hold good,—that if you attempt great muscular labour, and do not consume animal food to a proportional extent, you cannot sustain your strength on light bread. The practical question then is, I think, decided by experience, as to the *sustaining* power of compact bread; the question of its *digestibility* will be presently considered, and it is evidently quite distinct from that of the *sustenance* to be obtained from it when digested.

The practical inference, then, to be deduced from these considerations is, that since the gain by fermentation is doubtful, and the loss, in some respects, certain, as regards its alimentary power, that this process ought to be kept within due limits, and only carried so far as to improve the *digestible* qualities of the dough.

While we admit that to some persons the fermented bread, and even the lighter or more porous forms of it, may be found more digestible, yet there are not wanting instances where the contrary is found to be the case. It is taken too much for granted that, as a general rule, fermented bread is found to be the more digestible, while the contrary case is considered a mere exception. If the question were fairly put to the test of experiment, I am not sure that this assumption would not be *exactly reversed;* for be it observed, that *unfermented* bread may be produced of a sufficiently *light* and porous quality—and the process by which this may be effected is well known,—yet we venture to think it is less frequently adopted in household economy than its merits and utility deserve. The following are approved formulæ:—

Mix carefully,—

Wheaten flour, 7 lbs.
Carbonate of soda, 350 to 500 grains, *i. e.* about $\frac{3}{5}$ths of an ounce.

Mix, and add to flour,—

Water, $2\frac{3}{4}$ pints.
Muriatic acid,* 420 to 560 grains, *i. e.* a little more than the *weight* of the soda.

This is the *patent* unfermented bread.

Another is—

Flour, 1 lb.
Carbonate of soda, 40 grains.
Cold water, half a pint, or as much as required.
Muriatic acid, 50 drops.
Powdered white sugar, a teaspoonful. (This may be omitted at pleasure, without damaging the process.)

Mix the soda and sugar carefully with the flour by means of a *wooden* spoon, then mix the water and acid together, and add them so mixed to the flour, stirring constantly. Divide into two loaves, and put them *immediately* into a quick oven.

This last forms a delicious bread, and one which suits some stomachs much better than any fermented bread, and better also than any form of biscuit.†

* It is necessary here, however, to state particularly, that the muriatic acid—to be procured of the chemist for the purpose of bread-making—should be that only which is kept for medicinal use. The purpose for which it is required should be always stated; and this is very important, since the muriatic acid of commerce is totally unfit for internal use.

† What is termed *aërated* bread is made, I believe, by mixing the dough with water previously saturated with carbonic acid gas; its real merits can only be proved by time and experience.

There is, however, another form in which flour may be used without fermentation, and which is found, by experience, most beneficial, — *i. e.*, as a pudding composed of flour and water, with or without a small quantity of salt. This form of unfermented food is rejected, often without trial, from a mere prejudice, on account of its more compact form, as compared with fermented bread; but it is certain that to many persons it proves one of the most digestible, as it certainly must be from its composition one of the most nutritive, articles of diet; and this will appear plainly from one or two facts (to be mentioned shortly, p. 54), which put the seal of experience on this estimate of flour-and-water pudding.

Bread, then, as containing every element required both for renewal of good blood, and for the production of animal heat, is the chief substitute for meat; and we have, perhaps, convinced the reader that in some cases, at least, it is to be *preferred* in its unfermented form, and that, at the least, an excess of fermentation and the admixture of extraneous ingredients must greatly diminish its nutritive power. A want of attention to this point is, I am convinced, a fertile source of debility, which will persist and increase in spite of medicine, if this error be not corrected.

Pease and Beans.—The seeds of our leguminous plants take the next place in importance after wheat as an article of plastic or nutritive diet.

We have already seen that they even exceed wheat in the proportion of nitrogen they contain; but it seems they do not yield phosphorus—in this respect they are inferior. They have the repute of being somewhat indigestible; but a part of this evil reputation is probably

owing to the imperfect cookery to which they are subjected. *Do* they manage these things better in France? This is a question which I must leave to my readers who are versed in comparative cookery. I can only say that the comparative chemistry of these articles commend them as excellent substitutes for meat, in combination with bread or flour pudding, and a due supply of fat in the shape of butter, &c.

Facts will also be adduced to prove this opinion of their efficacy. (See p. 54.)

The deficiency of phosphorus renders it needful to have recourse to other articles in addition; and wheaten bread supplies the deficiency.

Besides the necessary nitrogen, so also is phosphorus (in the form of phosphates) and sulphur found in the fruits and vegetables in common use—as turnips, carrots, apples, pears, &c.

We see, then, that flesh and blood matter, and what is no less important, matter for the supply of the nervous system, may be supplied from the kind of food most pleasant to the taste of the majority of persons,—viz., the fruits, summer and autumnal, and the succulent vegetables of spring, which, though they contain nutrient matter in too small proportions to their bulk to afford support without the aid of bread, pease, beans, &c., yet they do assist in this process; and they have, besides, peculiar influence as correctives of the blood in some respects.

Whether their digestibility, even when well cooked, brings them within the power of the stomach, in any particular case, may be determined by cautious trial.

Turnip, Jerusalem artichoke, beet and other roots,

contain a certain proportion of *nitrogen;* and so far as this element can be considered a measure of nutritive power, they must be still valuable substitutes for meat, especially as compared with the mere varieties of starch, arrowroot, sago, tapioca, &c. &c., which contain absolutely no nitrogen at all, and therefore can only serve as producers of heat, and not of flesh and blood.

As to the digestibility of fruit, it is generally admitted that it is improved by cooking; but even in its raw state, after *due mastication*, it is not so difficult to digest as is commonly supposed. The positive observation of Dr. Beaumont,* that a raw apple was very quickly digested, may be set against the vague opinion to the contrary.

The truth seems to be, that some very weak stomachs can digest no raw vegetable food, and in general cooked fruit is to be recommended. Apple is best cooked, not by mere roasting, but by baking, being previously cut in *small* pieces, or by boiling, as in apple pudding. What is called *apple jelly* (see "Treatise on Cookery") is a delicious and wholesome food. The jelly obtained in this process is called by the chemists Pectin, though one can scarcely see the need of this new name, since it is only Greek for jelly.

* Dr. Beaumont, a physician in the United States army, as is known, perhaps, to most of my readers, had a patient, Alexis St. Martin, a Canadian, who had, as it were, a window in his stomach; it was made originally by a bullet, and did not close, although it had healed. Through this window the operations of the stomach were actually viewed, the relative digestibility of various articles ascertained, &c. A raw apple was very quickly digested.

In former days, the favourite English fruit apple had a high character, not only as a wholesome corrector of the blood, but a very nourishing diet; and this old notion is well borne out by experience. As an auxiliary nutrient, therefore, it cannot be too highly recommended, although, as we have said, from the small proportion of nitrogenous matter, neither this nor any other of either the summer or autumnal fruits can be relied on as a chief article of diet.

In speaking of the corrective powers of fruit, we would call the particular attention of the reader to an observation long since made by Liebig, that after eating freely of any of these—as, for instance, a plate of raspberries, there is evident proof, in the state of the excretions, that a considerable amount of alkali has been thrown into the system.

The explanation is this,—that in all acid fruits there is a large quantity of potash, lime, &c. combined with the vegetable organic acids, as malic acid, tartaric acid, &c., and that these combinations are very easily decomposed, the acids being altogether changed in their form, and the alkali set free to correct the blood.

That this correction is most salutary is evident from this—that by the concurrent opinion of many eminent medical observers, *a too acid condition of the blood*,* or its secretions, is the foundation of many troublesome and some serious disorders of the health. How much we

* The importance of this will be evident, when we consider that the watery part of the blood (the serum) contains much *albumen*, held in solution by the predominance in this fluid of *phosphate of soda*. An alkaline state of the blood seems, therefore, to be a condition essential to health.

may suffer from too exclusive an animal diet, particularly salted meat, uncorrected by the influence of fresh vegetables and fruits, is evident from the well-known case (of former days, rather than the present), in which "sea scurvy," with all its horrors, occurred so often during long voyages. And it is well known that no medicine without change of diet avails, while this last remedy is invariably and quickly successful.

Every medical man of experience must have seen many instances in which diseased states, closely resembling this of "sea scurvy," * have been induced by a similar peculiarity of diet—and this not the result of necessity (as in the long voyages alluded to), but adopted from mere ignorance of the laws of health in this respect.

We have a few words to offer respecting

Drinks.—We have already spoken of one class—that of fermented liquors, or those containing alcohol, considering them not as mere stimulants, but as *liquid aliments*, for they do nourish, not only by their alcohol, which is itself a hydro-carbon, and therefore capable of supplying those elements, but they also contain some small amount of nitrogenous matter dissolved in their water. This applies more particularly to beer, *i. e.* to malt liquors of every kind.

In so far as fermented liquors act as stimulants, they

* We should, I believe, see a much greater prevalence of such cases during our long English winters, when there is a dearth of vegetable food, especially in large towns, were it not for the ample supplies we receive of foreign fruits, more particularly *the orange*, which is so common and accessible, that we overlook, perhaps, its important bearing on health. We should become quickly aware of it, were we deprived of this boon for only one season.

are not nourishers, but *wasters, i. e.* they stimulate the vital processes, and we live *too fast.*

In this respect they are clearly injurious, excepting in those cases best ascertained by medical opinion, where they are required to stimulate the very functions of the digestive organs. They are then to be considered as a medicine rather than as elements of nutrition.

The medical man will judge of each case by itself, where he ought or ought not to advise such a medicine. We can only lay down this general rule, — that it will be better to make good blood by the aid of a glass of wine or ale, than to make bad blood by the want of it.

Experience, too, would be a good guide in this matter, were it not an unhappy fact, that a morbid inclination and habit too often obscure the clearest decisions of the judgment, and bring in a verdict opposed to the evidence—a verdict, in appearance only, *in favour of ourselves*, but in its reality most inimical to all our best interests.*

The transition from the alcoholic drinks to WATER, however difficult in practice, is easy on paper, and it forms a *refreshing* contrast.

We may agree with that brilliant writer, Mr. Lewes, that water should be regarded as an *aliment*, since it forms a necessary part of every tissue, and is a chief constituent of blood and all its derivatives; and as it

* We may here just express our concurrence with the Chancellor of the Exchequer's popular measure for introducing the wholesome wines of France; and if these are substituted for ardent spirits and brandied wines, the health of the community cannot fail to benefit by the exchange.

wastes, so must it be renewed. Besides, we are not certain that it may *not* be decomposed, and furnish its hydrogen and oxygen to the organs which require such supplies. The decomposition of water *out* of the body requires, we know, much chemical force; but we are not cognizant of the resources of the living organism, except to a very small degree; our ignorance of them exceeds our knowledge—but by *how much* we cannot tell.

We receive large supplies of water in the shape of food, for it forms a great proportion of almost all solids; and those who never drink *pure water* take much in the shape of tea, coffee, beer, &c. &c.

Can we take too much water? We believe we may do so, and that this is no very uncommon cause of debility. If from perverted appetite or habit, we receive into the system more water than it can appropriate to beneficial uses, it will be thrown off chiefly by the skin or the kidneys; but it will *carry away some other matters with it:* this is self-evident, as no *pure water* is ever discharged in any direction,—and it matters not whether we receive the water in the shape of tea or beer, or the simple element, if we receive more than a due supply, it must, in being expelled, carry something with it. Dr. Thudichum observes, "that a large quantity of water acts as a diuretic, *so long as there are soluble substances in the blood to be carried away with it.*" I have no doubt that the habit of drinking more of water or weak liquids than we require is a frequent though *unobserved cause of debility.*

Mr. Lewes, however, startles his readers (perhaps he knows well that not a few like to be startled) by assert-

ing that "*Water* is by far *more* nourishing than *beef*." He proves it thus:—You might deprive a man of beef for some days, and if supplied with water he would live; but reverse the process, and he would die. On this ground, air is still more nourishing than water, for deprive a man of water twelve hours, and he would live (though unpleasantly); if deprived of air for half the time, he would die; and it matters not to the argument that the air is received into the lungs, and the water into the stomach.

We have ourselves known an instance in which water was the only thing received into the stomach during *six weeks*.* The case was one of protracted *fever*, with relapses, but ultimate recovery. But to test fairly Mr. Lewes's maxim, the trial might be made in the following way:—

Let two healthy men be employed during a fortnight in equal and ordinary labour. Let one be supplied with a pound and a half of beef and two pounds and a half weight of water, daily.

Let the other have the same weight (four pounds)—but of water only.

If, at the expiration of the time, the last was found to have gained more or lost less in weight and strength than the first, we might agree with Mr. Lewes "that water is far more nourishing than beef."

Our readers will probably think that the beef-eater would have the best of it.

* This was the case of the late Professor Alison, of Edinburgh (a man whose memory is revered by all who knew him; and an old pupil and friend may be pardoned this heartfelt tribute by the way). We have been assured of the fact from his own lips.

But there is another class of drinks which have a fair claim to be considered alimentary—tea, coffee, cocoa (or chocolate, which is but a spiced preparation of cocoa).

In all these a peculiar *nitrogenous* principle is found, called respectively caffeine, theine, theobromine; so that though they are really *nutritious* in a small degree, yet their excitant properties are the most important. Liebig describes them as "*promoting the vital functions;*" but, like all other stimulants, they should be used but in very moderate quantities. Excess in them at any time is hurtful. And as they all, more or less, promote watchfulness, they ought never to be made a part of the last meal, if that be taken near to bedtime.

Cocoa is usually supposed to be *entirely* free from such influence; but the correctness of this opinion may be doubted, not merely from the close resemblance of its active chemical principle to that of tea, but from actual experience. It appears only to be somewhat *less* exciting than tea.

Cocoa contains oil, which is usually, in the manufactured article, combined in the gum and starch, so that it does not easily separate. This oily matter, although it may prove troublesome to some stomachs, is in some cases a positive benefit when it *can* be digested, as supplying a certain amount of fatty matter, of which the system stands in need.

Fat meats and fat drinks, as cocoa and milk, are denounced as unwholesome; but this sweeping condemnation of whole classes of aliments serves only to puzzle plain people in their choice.

The brain, and the whole nervous system, require, as

the chemist can prove, a certain supply of fat and phosphorus; and no less damage will arise *from withholding this due supply* than from accumulating an excess of it in the system. Such a term as "fat-headed" may serve to point a joke, but too great leanness has its evils also; and when the brain is in this condition, leanness of thought will exhibit its character as a necessary consequence.*

This state of things is by no means uncommon, physically speaking. How often, in literature, or in the senate, "lean and profitless debate" may be attributed to physical causes, is a question for the philosophers.

Cocoa or chocolate is well suited to those whose diet is spare in other respects, and whose habit of body is spare too.

To such also milk is most useful, containing as it does every element of nutrition, both the heat and flesh-producing, of which its fatty matter, butter, and its cheese, are respectively examples.

Cheese is highly nutritive, and its digestibility is the chief consideration in regulating its use. It is very useful as a substitute for meat, where little or none is taken, and, *so far as it can be digested*, may form part of the diet of all who cannot take meat freely.

For a weak stomach, or one in a state of fatigue from over exercise or long fasting, nothing is worse than a

* Lehmann (quoted by Dr. Christison) says that the infusion of 1 oz. of roasted coffee taken daily will diminish the *waste* going on in the body by one-fourth; and Dr. Christison says that tea will do the same.

full meal consisting chiefly of cheese; yet this is a mistake frequently made.

Now, having gone through the subject of diet in its most important aspects, and shown the theory which should guide us in our choice, it may not be out of place to adduce here a few authentic facts which have fallen within the writer's own knowledge. We shall then see how far experience and theory agree.

1. We have known very fine families reared almost exclusively on the following articles :—flour-and-water pudding (*i. e.* cooked *un*fermented wheaten *flour*), milk, and the usual fruits and vegetables of the season, to the entire exclusion of meat, beer, wine, &c.

On this diet children to the age of twelve have been maintained with excellent results as to their growth, strength, and appearance; but we see in this simple diet a large and adequate supply of nitrogenous flesh-producing matter—phosphorus, sulphur, &c., on the one hand; and plenty of starch and sugar, or heat-producing elements, on the other.

2. We have known an able seaman on board a ship-of-war, who took no other food or drink than these,—flour pudding (as above described), pease pudding, cocoa with sugar, and water—no meat, nor beer, nor spirits. Yet he was a model of athletic beauty and *strength*, and did his duty ably.*

3. The English peasantry, in many quarters, live chiefly

* Anderssohn, in his "Lake N'gamni" (quoted by Lewes), speaks of a Dane in his service remarkable for strength and endurance, who lived entirely on *thick sour milk*. In some parts of the country pigs are fed, for a time, exclusively on sour milk; and on this diet they grow rapidly.

on flour pudding, bread, bacon—mere fat,—and beans and pease, rarely tasting butcher's meat. Here we see all the needful elements comprised, the bacon fat of the peasant replacing the oily cocoa of the sailor, the other articles being the same. These facts, then, most exactly coincide with and corroborate our theory, and they show that a large amount of strength may be sustained on *fit* vegetable diet without meat. That which in these instances has been instinctively adopted as a substitute for flesh meat should be prescribed, *so far as the appetite and powers of digestion will admit*, to those who from any cause do not take abundance of meat.

Having so fully treated of the principles which should guide us in the choice of vegetable diet, we have no space to enter into the merits of every single article of food (*ab ovo ad mala*), still less can we find room to say much of cookery. On both subjects, diet and cookery, further information may be obtained from the following excellent works:—Liebig's "Familiar Letters on Chemistry;" Dr. Lankester's "Letters on Diet;" and his "Lectures on the Food of Man." *

* On one all-important subject—*purity of the water we drink*—we have space but for a few words. It is too well known that even the best of the water supplied by London companies contains a considerable amount both of mineral and organic impurities. The best water now to be procured in London is, it seems, that supplied from the *newly-erected fountains*. If that cannot be obtained, filtering through animal charcoal may in some degree lessen the impurity of the river-water; and this partial corrective should not be neglected.

CHAPTER V.

APPETITE, IN RELATION TO QUALITY AS WELL AS QUANTITY OF FOOD.

Causes of defective appetite, especially for animal food — Importance in this case of the *choice* of vegetable food—Food of the nitrogenous class alone capable of compensating the want of animal food — Inutility of medicine if this distinction be neglected.

We have now before us a clear view of the purposes of food, and of the distinction between the two classes into which all articles of diet may be divided; but it is obvious that we can make a practical application of our knowledge only so far as the appetite will permit. It is necessary, then, to consider this instinctive function in two relations, as it regards first the quantity, and next the quality, of food.

Debility, it is obvious, may arise from a defective quantity of food; but it is equally true, though not so obvious, that it may arise from an excessive supply. The evil consequences of excess in food are many, but one is so plain that it needs but to be stated: it is that, when we take too much food, *none of it is perfectly digested* or assimilated, and this can only result in increasing weakness. How are we to understand these terms too much and too little? How are we to lay down the rule to go beyond which will be excess, to fall short of it defect?

It is plain that, although physiology may determine approximately the average amount of daily waste in adult man, and consequently the amount of daily supply required to meet this waste, yet the adjustment of the matter is a question for each individual to determine by his own experience.

In general it may be observed that during the period of growth there is little danger of excess; there is much of defective supply.

On the other hand, in adult and middle age the case is exactly reversed. Here the danger is, in most cases, that of excess. It is quite marvellous to what extent food may be taken by young people who are growing rapidly, without the chance either of indigestion or plethora. The difficulty usually is to keep pace with the demands of the body in its rapid expansion.

I quote here, as a warning to those whom it may concern, the words of Dr. A. Combe on this subject:—

"In youth, not only must the waste of materials be replaced, but an excess of nourishment must be provided, to admit of the continued growth which is the chief function of our earlier years. If this be denied, the development of the bodily organs often receives a check which no subsequent treatment can remedy; and a foundation is laid for *diseases of debility*, which afterwards embitter and endanger life.

"In boarding-schools, especially for females, this important principle is often disregarded, while the conductors are at the same time without the least suspicion of the evil they are producing, and even take credit to themselves for only *checking sensual appetites*, and promoting temperance in eating as well as drinking."

The quantity of food, however, which can be taken advantageously, depends on the appetite; for there are but few instances in which food forced on the stomach contrary to its inclination is profitable at all. There are such exceptions, and all important they are when they *do* occur; but it does not concern us to dwell on them here.

What is to be done when, from want of appetite, the quantity of food taken falls short of the requirements of the body, especially in its growing state? It is easy to recommend bitter tonics, as gentian, quinine, and still more, strychnine (and these, especially the last, it belongs to the physician to prescribe; for, if injudiciously applied, they may do harm), yet they often fail unless accompanied by a proper regimen. This consists chiefly of exercise and moral discipline; for let it never be forgotten that moral causes have an all-powerful influence, and often the tonic medicine, the exercise on horseback, &c., all duly enjoined and duly applied, entirely fail from inattention to this part of the treatment.

It is certain that the influence of depressing passions of the mind is quite enough to defeat all efforts of medicine and regimen directed to restore a healthy appetite, and it is moreover only in a few cases where it is within the limit of human power to remove this fertile source of disease. "To minister to a *mind* diseased" is always a hard, often an impossible task. But let us suppose that to the aids of medicine and exercise have been added those of mental and moral influences, so far as circumstances admit, and that we have thus obtained the greatest amount of appetite for food our case allows us to reach, and our next consideration will be the *quality of food* we should choose. This, of course, as well as the

quantity, must be limited by the appetite or taste of our patient. There may be for some kinds of food much less desire than for others, and for some, indeed, an absolute repugnance.

This is particularly the case in certain states of disordered health of female adolescence.

Young women in a weak, bloodless, and consequently *irregular* condition, are enjoined to eat much meat; but in spite of the medical injunction (which is of course theoretically correct), meat in *any* quantity is just that thing they have in abhorrence.

In this case, it too often happens that the regular advice having been duly given, and as regularly disregarded, nothing further is done, and she who cannot eat *meat* may eat anything or nothing; as if among articles of vegetable diet there could be but little difference, and one might be as good or no worse than another, so long as the prescribed meat is rejected.

To this subject of the *choice of vegetable food* I beg the particular attention of my readers, assuring them that it is all important.

Mistake or neglect on this point is, I firmly believe, *the special defect* which so often renders the whole treatment abortive, however scientific or judicious it may be in other respects.

To my professional brethren I would venture to say,—What can your best prescriptions avail if, while following them, your patients are permitted to starve themselves? *You*, of course, do not permit them; on the contrary, you have done your duty in advising the predominant use of that diet which is, according to known chemical laws, best fitted to recruit their impoverished blood—animal diet, of

course. But then, they do not like it; and if it is hard to persuade human nature, under any conditions, to submit to what it does not like; if

> "He that complies against his will,
> Is of his own opinion still,"—

what *can* be expected of woman's will, when her tastes and inclinations are firmly set against the doctor's advice?

She will not and cannot eat the meat, though seasoned with the assurance that it is best for her.

And now, to my patient readers I would just say,—that if you will not or cannot take the diet best for you, at least you might reasonably wish to find that which is the next to best. And yet in this respect you are so liable to err for want of information, that you are perhaps substituting for the animal diet just those very articles of vegetable food which are the *least* calculated to supply its place; and this not from taste, for you might even prefer the *fitting* substitutes, if you did but know them, to those unfit ones on which you are now starving, merely because they happen to come first to hand.

In this case, to guide our choice of the most appropriate substitutes for meat (as far as appetite will admit), it is only necessary to refer to what has been said at page 28.

It will there be seen, that after milk, eggs, and cheese, which come nearest in their qualities to meat, there is the following list to select from. We state them in their order, beginning with the most nutritive.

Sound wholesome bread, flour cake or flour pudding, together with macaroni, vermicelli, and similar prepara-

tions of wheat flour; oat or barley cake; peas and beans; roots—as turnip, beet, salsafy, &c.; carrots, kale, cabbage, &c.; fruits of every kind; and these last have the double advantage of yielding at least *some* nitrogenous supply to the blood, and at the same time of *refreshing* the stomach, and thus preparing it for the reception of stronger aliments.

There is, let it be remembered, more flesh-and-blood-producing aliment in an apple than in a basin of arrow-root, sago, &c.; though these last articles need not be excluded from a vegetable dietary, as they will be required for their heat-producing qualities.

It may be observed that the low, bloodless condition above referred to, and with which this repugnance to animal diet so often coincides, is frequently accompanied with a very defective production of animal heat.

The starch diet, however, although it supplies the material for the production of heat, will not actually increase it, unless accompanied by a quickening of the vital actions which can alone educe heat by the conversion of this material. To promote this, exercise as far as can be borne must be used; and a judicious supply of wine or sound malt liquor will be also needed.

CHAPTER VI.

AGE IN RELATION TO DIET.

Adaptation of diet to infancy, to youth, or the period of growth, and to old age—As to quantity of food, deficiency to be feared during period of growth—Excess to be avoided during adult life.

Before we quit the subject of diet, we wish to say a few words on its adaptation to different ages.

We have spoken already of the period of growth generally, but not of the two extremes of life—infancy and old age.

For a new-born infant the only proper nourishment is the mother's milk; and we must say here that no mother is justified (even if her want of natural feeling should permit her) in declining this office of nursing her child, unless on medical authority she is enjoined to do so; and no medical man is justified in sanctioning such a violation of the natural law, except on the ground of imperative necessity.

When, however, this is the case, of course the best substitute is the milk of another woman. Even this is sometimes denied to the poor infant, either from culpable neglect or from necessity.

To bring up a child *by hand*, as it is termed, is no enviable or easy task: and it is certain that the attempt utterly fails in a great number of cases. The rate of

mortality, as is well known, is largely increased among this class of infants.

Many attempts have been made to produce by artificial mixture an exact imitation of human milk, and it is said with some success.

The milk of other animals besides the cow has also been used, more particularly asses' milk; it contains a rich supply of sugar, and it is not deficient in caseine, that is, in nitrogenous aliment.

The milk of the sheep and goat affords a still larger proportion of this ingredient caseine than either human milk or even cows' milk; but if, as Dr. Carpenter remarks, its "curd is peculiarly dense," we may conclude that, on the whole, *diluted* cows' milk, to which *milk sugar* or ordinary cane sugar may be added, is the best adapted for very young infants; or when it may be conveniently had, asses' milk *un*diluted.

As the period of teething approaches, the addition of a gruel, made by boiling brown wheat meal (which is preferable to fine flour), to the milk will be useful.

In cases where, from debility, the period of teething is delayed, and the nutrition seems defective, animal broths—and sometimes even solid meat, in a state of very minute division—with gravy and crumb of bread may be given.

I agree with Dr. Druitt,* that the idea of waiting for the teeth before meat is given is a mistake in this case, and that the very delay in their appearance indicates that defective nutrition for which meat is the best remedy.

In such instances the addition of lime water to the

* "Manual of Surgery."

milk, given as drink, in equal proportions, is also very useful.

In extreme cases, phosphate of lime may be administered, either as medicine, or dietetically—in the shape of jelly made from ivory dust.

I need only refer my readers to what has been already said, to warn them against the old error that arrow-root and jelly are equal, or even superior, to wheat flour. They are quite useless as substitutes for wheat flour, though useful as adjuncts: for the arrow-root contains no nitrogen, and the gelatine contains it in such an organic form that it cannot be assimilated.

It is necessary here, however, to put in a word of caution against the *abuse* of chemical knowledge and of dietetic experiment.

On *both* these grounds it has been ascertained that gelatine will not accomplish *all* that was once attributed to it; but we are in the present day in danger of *under*-valuing a most useful restorative.

The benefit of gelatine in diet is established by incontestable proof: it will do *much*, though not *all* that is required for the emaciated invalid. The path of practical wisdom is between the two extreme errors we have pointed out, and gelatine, when it can be easily digested, ought to form part of a convalescent's diet.

The diet fitted for old age will be easily understood, if we consider the change of condition which takes place at this period of life.

The activity of all the functions is diminished, and a corresponding change takes place in our personal habits. There is accordingly much less *waste* in all the tissues; and this is marked by the smaller quantity of *urea* which

is found by observation to pass off in a given time, as compared with the average quantity produced in middle life.

Urea contains no less than 46 out of 100 parts of nitrogen. It is with good reason held that it is derived from the disintegration of animal tissues, which is inseparable from their activity. Urea is therefore a measure of the *waste* of flesh and blood.

Is it not evident, then, that large supplies of nitrogenous food must be not only unnecessary, but hurtful? For superfluous nitrogen is the basis of many morbid products, which help, over and above unavoidable infirmities, to embitter old age.

The same views will apply to the smaller amount of carbonic acid thrown off at this period of life, when compared with others where all the powers and functions are in full play.

The waste of carbonized material being less, the supply of that should be less also. In short, light diet in moderate quantities is best suited to the aged. The object is to maintain as much as possible the little remaining activity of the vital functions—respiration, circulation, and the action of the skin.

While gentle exercise promotes all these, there is no doubt that the most powerful auxiliary at this period of nature's infirmity is the moderate use of good wine. Its effect will be, by quickening all the vital functions, to *promote excretion*, which at this stage of life is the great desideratum.

Our recommendation of this combination of light diet and the use of wine must be taken only as a general rule, which of course has its exceptions. Special conditions of

disordered health will naturally demand modifications adapted to each particular case, yet we cannot but express a decided opinion that much discomfort to the aged often arises from overloading the already encumbered frame with what is called nourishing diet, in quality and quantity better fitted for the stages of our life in which work and waste are in full agency.

CHAPTER VII.

DIGESTION, ASSIMILATION, AND NUTRITION.

Meaning of these terms — Organs by which these processes are effected—The stomach, intestines, liver, pancreas,* &c.—Mastication, importance of—Salivary secretion, use of, with a caution as to *smoking:* its use and abuse—Digestion not effected in the stomach exclusively — Production of *chyle;* of what it consists —Mode of its absorption, and of its supply to the blood—Its selection and elaboration by *cell-agency*—Its further elaboration in passing through the mesenteric glands and the thoracic duct — Practical application of the foregoing — Rules for obtaining good digestion—Influence of mind on body, and *vice versâ*—Answer to objections made to these views, and the importance of blood disease established—The humoralist, the solidist, and cell-pathologist may harmonize, but cannot exclude each other—Virchow's opinion.

THE blood may become defective in quality from an imperfect performance of the functions of nutrition—*digestion* and assimilation.

* The pancreas is that which is well known in diet as "sweetbread," and it has been thought remarkably easy of digestion. That in the human body it is most *important* in the *process* of digestion we shall see further on.

Nutrition, or the nourishing process, is that by which the waste of our bodies in every part is made good by fresh materials of the same kind and character.

Digestion is the first step in this process, for by it the crude matters of every kind taken into the stomach are prepared in a fluid form to enter the vessels intended to receive them.

Assimilation is the second step,—the term is merely an expression of the fact that this fluid so prepared is transformed by a mysterious process—whose intimate nature we cannot at all penetrate—into the various and so apparently different substances which make up our whole frame.

The white of an egg, for instance, is transformed into that vital substance termed *fibrine*, which in our muscles has a contractile power. The egg consists chemically of albumen. This, by cooking, is coagulated; but it is still albumen, only rendered insoluble. By digestion in the stomach and intestines it is rendered again liquid, and forms *chyle;* then, further on in the process, in passing through various vessels and organs, it is changed into fibrine, with properties quite new, and capable of obeying the stimulus conveyed through the nerves; and thus acting *at our will* with all the force of muscular power.

The very first step in digestion begins with the mastication of food, for even this is something more than its mere division. It is well ascertained that, under the influence of the saliva, food undergoes a great change in this first stage; some of it even undergoing a marked alteration in its chemical character.*

* *Smoking.*—It may not be out of place to put in here our *caveat* against the *abuse* of smoking; for, although this abuse has many

The importance, therefore, of the rule that *all* food, and especially animal food, should be eaten slowly and with careful mastication, is evident on both these grounds. Other things being equal, there is no doubt that the digestibility of food is exactly in proportion to the minuteness with which it is divided when taken into the stomach; for on this state of division depends the amount of surface which is exposed to the contact and action of the *gastric juice*, of which we have presently to speak.

A few words, however, may be first offered respecting

other consequences besides the waste of saliva, yet this is one of its well-marked evil results.

From what has just been said of the use of saliva in beginning, as it were, the process of digestion, the importance of avoiding the waste of this secretion may be estimated.

Without entering into the vexed question respecting the use of tobacco under any circumstances, we will just state the cases in which we consider it an evil to be entirely avoided.

1. Where it excites too free a flow of saliva (for the reason just stated above). It has this effect on some persons long after the habit has been established.

2. During the whole period of growth.

3. In all cases of defective nutrition, usually accompanied by more or less nervous debility.

In all these instances its use should be discarded altogether; and if, under other conditions, it may be tolerated, there can be no doubt that if carried beyond very moderate limits, it may seriously injure the powers both of the mind and body.

The moderate use of tobacco is certainly less hurtful—in some cases, perhaps, beneficial—when employed after a meal, rather than on an empty stomach. In this we agree with Mr. Lewes, though *one* of the great uses of tobacco has been held to be to allay painful hunger, as in the case of travellers, hunters, and soldiers deprived of rations. Where the *choice* exists, *we* should prefer to smoke rather on a full than a starving stomach.

the act of swallowing, by which the food is conveyed into the stomach, and also respecting the stomach itself.

The act of swallowing is rather more complicated than the general reader may be aware of. In this act, a number of muscles are called into play, and their action is governed by a concurrence of nervous influence, without which their action would be inharmonious, and consequently ineffectual. There are certain derangements of the nervous system which materially disturb this nervous influence; and this is the explanation of that difficulty of swallowing food not infrequently complained of by delicate, nervous, and hysterical persons. It is often one of the most marked indications of such a state, and the experienced medical man knows well that it is owing to no disease *in* the throat, as the patient is so apt to imagine, but that it is dependent on more remote and general causes; that it is to be removed and remedied only by prescribing for the improvement of the general health.

The stomach which receives the food after mastication may be described in general terms as a *hollow muscle*, lined with a delicate mucous membrane, and furnished with numerous glands.

From the coats of the stomach, as soon as any irritation is applied to them (and the presence of food affords that necessary excitement), a fluid is poured forth, called the *gastric fluid* or juice; the essential constituent of which is a substance which has received the name of *pepsin*.* The chief thing to be noticed is, that the

* The *product* of this digestion has accordingly been termed *peptone*, which means simply the *albuminous* substances reduced in the stomach to a *soluble* condition.

secretion of gastric juice, although not caused by any nervous influence,—for it seems to be formed independently of it,—is yet, as Dr. Carpenter has expressed it, very much *influenced* by the nervous condition:—"The quantity of the gastric juice is increased by exhilaration." And this, if it be admitted, shows the need of dismissing as much as possible (and much may be done in this way by a resolute direction of the thoughts in a proper channel) all anxious cares at the time of meals. Hence the custom of our ancestors—and indeed, more or less, of all times and countries—to accompany the taking of food with some means of diversion. In some quarters music is the accompaniment, and a very proper one.

Nothing militates more against digestion than when either the muscles of the stomach are in a state of weakness from long fasting or general fatigue, or the nervous system is exhausted by too great previous thought—or, still worse, accompanied by care, that "canker of the mind." Let, then, the grace before meat be not only a giving thanks, but a remittance, as it were, of all anxious cares and questions into His hands who has given the food, and good promises to our hope beside. Then let cheerful converse at least, and social affections—the play of beaming eyes and glad faces—keep us in good humour with our meat, without which our meat may likely disagree with *us*.

The action of pepsin in producing a solution of the food seems to be of a chemical character.

Dr. Carpenter (Phys. p. 505) on this point says:—"The theory of chemical solution, which was at one time regarded by many as quite untenable, has been of late

years so much strengthened by new facts and arguments, that there appears no solid reason for withholding our assent from it, even though it cannot yet give a complete explanation of the complex phenomenon in question."

The most convincing proof of the correctness of this view is, *that food can be digested in the gastric fluid, even out of the body;* but one circumstance should be especially noted, as giving an important practical suggestion. It was found by experiment that food could not be so digested out of the body unless kept in a certain temperature,—about 100°.

And I may here say that to the weak and delicate stomach, where digestion is always a difficulty, there is no more efficient help than that derived from warmth applied externally to the region of the stomach.

This may be done either by means of a piece of flannel, well warmed, and applied to the pit of the stomach; or a piece of what is called spongio-piline may be warmed and used in the same way. In some cases it may be advisable to maintain the warmth for a more lengthened period, by using (over a piece of flannel) a bottle or tin vessel filled with hot water.

The effect of such an application in promoting coction, and the comforting effect on a weak stomach, can be best appreciated by those who have tried it. It is in this way that a glass of hot water, or, in cases of great debility, coldness, and in advanced age, hot spirit and water (brandy or whisky), sometimes proves very beneficial. To those who make theoretical or fanciful objections to the use of spirits in such cases, I would repeat what we have already said respecting wine and ale, that it is better

to make good blood by the aid of stimulants, than to make bad blood for the want of their help.

The influence which the nervous system has on the secretion of gastric juice is, perhaps, the reason why, according to universal experience, entire rest from any muscular exertion, or any strong efforts of mental attention, is needed immediately, and for at least an hour, after taking food.

After the secretion is fully established, and during the subsequent period of the stomach's action on the food, gentle exercise is found beneficial, that is, exercise enough to promote, by the slight motion of the food in the stomach, as in quiet walking, the *muscular* action of this organ, by which the food is more perfectly mixed with the gastric fluid. Any greater exertion may hinder the continued secretion which is still needful.

The time required for digestion has been stated by Dr. Beaumont for the following articles:—rice and tripe, one hour; eggs, salmon, trout, apples, venison, one hour and a half; tapioca, barley, milk, liver, fish, two hours; turkey, lamb, potatoes, pig, two hours and a half; beef and mutton, three hours and a half, and both were more digestible than veal. Fowls were like mutton in their degree of digestibility.

Animal substances were in general converted into chyme more rapidly than vegetables.

The influence of the nervous system on the movements of the stomach seems greatly increased during the period of digestion, so that "while the stomach is digesting, the pylorus (that is, the lower aperture of the stomach) is too irritable to allow anything but chyme to pass; but when digestion is ended, the undi-

gested parts of the food, and even large bodies—coins and the like—may pass through it." * The mass of digested food, or chyme, then passes gradually into the small intestine, which is immediately connected with the stomach.

Of the changes which the food undergoes after passing out of the stomach into the small intestines, much less is understood than of those effected in the stomach.

The small intestines are furnished with numerous glands of peculiar structure, and of three kinds; but, although their anatomy is curiously interesting, little is definitely known of their functions. Into the small intestines also is poured the secretion of the pancreas, and that from the liver. Opinions are yet unsettled as to the offices of each.

That of the pancreas is supposed to be, to bring fat matters into a state to be assimilated, and the liver is capable of converting into sugar of a peculiar kind articles of food having no sweet properties at all. The large quantity of bile formed by the liver is thought to be the chief agent in changing the chyme, which as it passes from the stomach is of an *acid* character, into an *alkaline* condition. The action of each of these is probably necessary to the perfect accomplishment of digestion in this stage.

The latest observations on the office of the *pancreas* show that its secretion (the peculiar principle of which is called PANCREATINE, and which efforts are now making to obtain in a pure state) has the property of *supplementing* the office of the gastric juice, or pepsin; that is

* See Kirke's "Physiology," p. 241.

to say, that the albuminous substances which are not entirely digested in the stomach are acted on and digested by the pancreatic secretion. But it is a curious fact that this secretion has *no* action on matter which *has* been fully digested in the stomach; and that, moreover, if the pancreatic secretion be mingled with the gastric fluid, the power of *both* is destroyed: they seem to neutralize each other. The pancreatic secretion has the power of converting starchy matters into sugar as well as of digesting albumen, also of forming an emulsion *with fat*. With regard to the sugar-forming function of the liver, much doubt seems entertained whether it is really a vital function. The peculiar liver sugar, or *glucose* as it is termed, seems to be formed in yet greater abundance in the liver for some hours after death; the process, therefore, is perhaps merely chemical.

According to Bernard (one of the highest authorities on this subject), the action of *bile alone* in the chyme would be to render the albuminoid substances again *in*soluble; but, by the action of the pancreatic fluid and of that derived from the glands of the small intestine, the solubility is restored. We find, then, that the *intestinal* digestion is no less important (in the opinion of some it is much *more* so) than that which takes place in the stomach. It is certainly to our view more complicated, including the action of three distinct fluids—the intestinal, the pancreatic fluid, and the *bile*.

One certain practical conclusion we may rely on, that the secretion of bile is *all important*, either for its use in the animal economy, or for its power of cleansing the blood of all matters which are noxious if allowed to remain in it.

When from any cause the secretion or evacuation of the bile is suspended, we do not fail to mark its evil results in a variety of ways. One result is evident to the eye, in the yellow skin—jaundice, as it is termed; and this state is usually accompanied by great debility.

And now, what are the most usual causes of these disorders of the liver? We put aside two, as unconnected with our object, being usually beyond the control of the patient: these two are, exposure to a hot climate, and to the influence of malaria, or aguish air.

The other causes are within our control, and they are—1. *Excess in food*, measured in relation to the amount of our labour or exercise; 2. The use of ardent spirits, and the abuse of *any* fermented drink, as beer, ale, porter, wine, &c. With regard to the first cause, little more is needed than to have pointed it out, and more particularly to have called the reader's attention to the true character of excess, which is entirely relative. An amount of food, especially animal diet, which is but a fair supply for the waste of one who takes a large amount of strong exercise, would be enormous excess for one who takes but little. He might even take *half* the quantity of food, and still be in excess.

It cannot be too often insisted on, that as food is intended to *balance the waste* (in the adult body beyond the period of growth), so must its quantity be measured by that waste, be it little or much.

In making this estimate, however, it must not be forgotten that even mental occupation and exercise does really occasion a *waste* of the bodily organs through which the power of thought is exercised, and we must take this

into account. At the same time let us observe, that as this waste goes on chiefly in one part of our system only, the brain, it is not a proper substitute for the salutary effects of general exercise of the body. The condition of health requires for its maintenance a due combination of various exercises—some of the brain, some arm-work, some of the locomotive organs; and by the exercise of these, the circulation, the respiration, and other functions are quickened and promoted, as we shall more fully show when considering these functions.

We need say no more at present than that full-feeding and inactivity—either, or still more certainly both—are sure to produce liver disorders.

Another cause of these disorders is anxiety of mind. The influence of the mind through the medium of the brain is most distinctly shown by the fact that a piece of ill news suddenly communicated, disappointment, and, still more frequently, anger, have been known to produce a sudden fit of jaundice.

"From envy, hatred, malice, and all uncharitableness," unless the "good Lord deliver us," we shall never make good bile or have good digestion.

We may then wisely try, in making the above prayer, *to do what we ourselves can* to help the deliverance from these evil passions.

There is a just and popular objection to that species of logic which takes the circular form, but it is certain that the causes and consequences of physical disorder often do run into a circle. For example, gloomy or evil thoughts tend to produce disordered liver; and this in its turn is a cause of our looking at things and people too with a jaundiced eye, and disposes us to stir up the black bile

that is in us all more or less, on very trifling occasions, or without any occasion at all.

The ultimate result of digestion, when completed in the small intestines, is the formation of the fluid called *chyle*, that liquid which, after passing through the lacteal vessels and mesenteric glands, is poured into the veins to mingle with the blood on the right side of the heart; and then, after passing through the lungs and returning to the left side of the heart, it is fitted to supply fresh materials to the blood, which from the heart is sent over the whole frame by means of the arteries; thus supplying to all organs the living matter which is to maintain the functions of the whole.

The whole of this process, from the beginning to the end, is full of most curious and interesting details; which, however, in such a work as this, would be out of place. We can only give a short outline of it, and dwell on those points which have a practical bearing.

Many persons are in the habit of judging of the perfect performance of the digestive functions by the sensations they experience during the half-hour which immediately succeeds a meal; but this is a great mistake. The truth is, that although when we do feel oppressive pain, or even uneasiness, soon after a meal, we may be sure that there is something wrong, it does not follow that when we are free from these uneasy sensations, we may feel assured that all goes right in the matter of digestion; and this will be evident from two considerations.

1. That many states of indigestion, even in the stomach, during the first stage, are not accompanied by pain or any evil feeling. This was observed by Dr.

Beaumont, in his well-known case; he *saw* that digestion did not go on rightly, when his patient was not at all aware of it himself.

2. We must remember that it is, speaking generally, two or three hours before the first stage of digestion is accomplished in the stomach; and to this succeed the further changes which we have described in the small intestines. This second stage of digestion may be, and often is, very ill accomplished, without giving rise to any immediate troubles.

The evil consequences of the imperfection of this stage are ultimately felt, no doubt, and that too surely; but even then, next day, or when the evil is gradual and accumulative, after many days perhaps, it is not pain that is felt, but only that debility which results from the continued supply of defective blood, or rather of chyle, which is not capable of being assimilated or of producing good blood.

Here, then, we have the second of the two chief causes of debility: the first being the inadequate material employed as food, and the second the imperfect function of the organs which should convert it into nourishment.

It is easy to see that in vain is the stomach supplied with the best-chosen material, if it is spoiled in the process of digestion or assimilation.

The chyle, the result of the last process of digestion, is found in the small intestines as a milk-white fluid; this appearance being attributed to an immense number of minute granules, visible as distinct bodies under the microscope, of which between 20,000 and 30,000 go to the inch. It consists of about $3\frac{1}{2}$ parts of albumen and

3½ parts of fatty matter out of 100 parts, 90 of which are water.

The chyle, then, is an albuminous fluid, in which particles of a fatty nature are floating, just as the red particles formerly described do in the liquor of the blood. This at least is the state of chyle as it is at first absorbed from the surface of the small intestines; but it attains a more perfect character in its progress towards the blood, becoming more like to this vital fluid as it advances. Chyle has been termed, indeed, "rudimentary blood." (See Kirke's "Physiology," p. 286.)

"The higher in the thoracic duct the chyle advances, the more is it in all these respects developed—the greater is the number of chyle corpuscles;" that is, of those bodies which give to chyle its peculiar and essential characters.

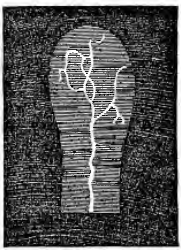
The mode in which the chyle is taken up or absorbed from the surface of the small intestines is so extremely curious and interesting, that we cannot refrain from placing it before the reader. It will be an example of the part which the *cell*—the ultimate constituent of all organized bodies, whether vegetable or animal—plays in carrying on that life of which it is the first product. The following is the description of a cell, by a distinguished author:—"The whole organized body may be regarded as a congeries of cells having different endowments, each set being concerned in special acts connected with abruption, nutrition, and secretion, wherever an action of *selection* or elaboration has to be effected."

Before we proceed to show how wonderfully the cell fulfils this office of selection and elaboration in this case of the absorption of chyle, we may observe that there are

two channels, quite distinct from each other, by which chyle can be conveyed from the small intestines into the general system.

The first mode is by the capillaries, or small network of blood-vessels, which is spread out on the small tufts (villi) of the intestines, and in this way it is conveyed *directly* into the blood.

The second mode is by means of a peculiar system of absorbent vessels called *lacteals*, from the *milky* appearance of the fluid they contain. These lacteals form branches, which pass through a set of glands (the mesenteric); and on emerging from these they unite, and terminate at last in one trunk, called the thoracic duct, which terminates in a vein near the heart.



Termination of lacteal in a tuft (or villus) of intestinal surface.

From what has been already said, it is evident that this circuitous route, as it were, from the bowels into the blood, is not without a most important purpose; since, as has been observed, the chyle becomes more and more perfected as it proceeds on its course and approaches more and more nearly to the character of blood. Yet it is no less certain that absorption does take place through the blood-vessels directly, for it is not only in accordance with comparative anatomy—since in some inferior animals (the invertebrate) there are *no* lacteals, and absorption of chyle *must* therefore be carried on through the blood-vessels alone—but the absorption through the veins has been amply proved by direct experiment. In what proportion the nutriment is actually

absorbed by the blood-vessels, and in what by the lacteals, is at this moment one of the most interesting questions of physiology; and it is probable that it has an important bearing on the nature of some particular diseases, especially those of the tubercular class. All that is at present known—and even this is full of interest, is that all very soluble matters pass more readily through the blood-vessels; while the *in*soluble, or solid matters of food, very finely divided, pass through the lacteals, especially the products of fatty aliments.

All substances which are noxious, or even extraneous to the animal system—matters not capable of being assimilated, pass through the veins; while those adapted to form part of our bodies are absorbed by the lacteals, the *cells* about to be described performing the office of selection and elaboration.

This matter is so exceedingly interesting, and gives such a striking example of the functions of *cell* life, that I hope the general reader will pardon the details here given, which might otherwise appear adapted for the medical reader only. Besides, I think at least one *practical* lesson may be drawn from the consideration of this branch of our subject, while it is inferior to none in affording an insight into the marvellous wisdom and contrivance of the Creator's work, exhibited here in the very first step of the process, which is to nourish and sustain a fabric which only Divine Wisdom could have devised.

The tufts (or villi), of which we have spoken as abounding on the surface of the intestine, comprise in their structure both the capillary vessels of which we have spoken as one channel of absorption, and also the lacteals,

forming the other channel, and which seem to terminate in the tuft in *loops* (as in the annexed figure, p. 80).

The capillaries seem to differ in their mode of distribution and arrangement from the same kind of vessels seen in other parts.

Perhaps the difference may be for the very purpose of fitting these last for their function of absorption.

Coming now to the *Lacteals.* The *cells,* of which we have spoken as the organs by which they absorb, are thus described by Dr. Carpenter (page 132) :—"They form a cluster at the extremity of each of the villi of the intestinal tube, the origin of the lacteal being lost in the midst of it. If examined whilst the absorbing process is going on, they (the cells) are found to be turgid with a milky fluid, which is evidently the same with that of the lacteals. The cells *select,* absorb, and *prepare the nutritious matter by making it a part of themselves;* and when their work is accomplished, they deliver it to the lacteals by their own rupture or deliquescence." *

The consideration of this beautiful mechanism of absorption (if we may so term it) is calculated, however, not only to excite our admiration, but to afford us a practical caution. We see how delicate the whole process must necessarily be, and that much depends on the function of *selection* and elaboration being duly performed by the cells: and if we disarrange this beautiful workmanship by any rough usage, what can we expect but a perversion of the process itself, or a hindrance to its performance, to say the least? Such a consequence we may reasonably

* These cells are now known to be those of the intestinal lining (*epithelium*).

expect, from two causes: 1st, intemperance, and excess in food or drink; and 2nd, the mixture of substances with our food not intended or fitted for nourishment; in other words, the adulteration of food and drink. For, in either case, one of two results may follow: either the rejection of the nutrient fluid altogether when the sound material is too intimately associated with the unsound to be absorbed separately, or else both may be absorbed together; and so the fountain of our blood is vitiated at its very source. For, let it be remembered, that although usually, and in the perfect performance of their function, the cells will only convey fit materials into the blood, yet, under certain conditions, they seem to exercise this selective power no longer, or so imperfectly, that inappropriate matters *are conveyed into the lacteals.* Their power may be overtaxed, and so perverted, just as an over-driven or over-whipped horse may resent the abuse by doing things he is not usually capable of.

There is great reason for attributing some forms of habitual looseness of the bowels, usually accompanied by great debility, to this cause. The delicate work above described is no longer satisfactorily performed; a great deal of the nutriment passes away *un*absorbed; and so, while the patient may eat much and drink more, he may become daily weaker; indeed, he may be on the road (with a more or less rapid course) to premature decay and death.

This will be the case where the chyle is rejected altogether—where it is absorbed either in an imperfect crude condition by the lacteals, or is at once conveyed through the capillaries into the torrent of the blood; in which case, it misses all that process of elaboration

which, as we have seen (page 79), it undergoes in its progress through the mesenteric glands and thoracic duct. It must necessarily supply the blood with defective material.

This process it is which, very probably, produces that disordered condition of blood which results in various diseases, of which the tubercular class (consumption) is one example. The true root of consumptive disease is to be looked for, *not* in the lungs (although, for very obvious reasons, this state of blood may show itself first in those organs), but it is to be found in the *root of organic life* itself, which is *the absorbing surface of the intestines.*

It has been already observed that, as yet, we know not in what *proportion* absorption is carried on by the lacteals and the blood-vessels respectively; but this is very evident, that the process effected by the blood-vessels must be considered the lower process as compared with that performed by the lacteals. To make good this position, we need only refer to the fact of comparative anatomy already mentioned, that the blood-vessels alone absorb in the lower animals—the *in*-vertebrate, while to the more perfect is added the system of the lacteals.

And it has also been mentioned that, according to the observations of the best physiologists, the chyle undergoes a progressive elaboration in passing through this system of vessels, and the glands associated with them. It would appear, then, that absorption by the blood-vessels is of the nature of a *less perfect*, but *quicker*, process than that by the *circuitous* and slower route through the lacteals and thoracic duct,—one of nature's short cuts, as it were, and yet, perhaps, very needful.

Not only may soluble matter be regularly conveyed through this channel in health; but in disease, or under temporary pressure—as of long fasting—even more solid matters may so be *quickly* thrown into the blood, by which a quick restorative may be supplied to the exhausted frame. But if this temporary and exceptional case became the habitual rule, crudity of the blood and blood diseases might ensue. Here then, so far as this view is well founded, we have another practical rule suggested; which is, that long fasting and exhaustion should be avoided, so that nature should have *time*, as it were, to effect its restorative work in the *most perfect* way, which is usually, in all its departments (in the physical and moral world alike), the slowest way.

It has been already observed, that the lacteals conveying the chyle all terminate in one trunk (the thoracic duct), and in this trunk other absorbent vessels, called lymphatics (from the clear liquor or lymph which they convey), also terminate; the whole contents of the trunk thus mingled, of chyle and lymph, are then poured into the veins near the heart.

We need not dwell on the lymph, the nature and uses of which are little understood,—and at all events, it has little connection with our practical object.

The new material thus added to the blood is not, however, fitted for its offices until it has gone through the lungs, there to be further elaborated and completed. We have, therefore, briefly to sketch the process by which this is effected, and by which the blood so completed in its nature, is conveyed to every part of the body. The circulation and the respiration come, therefore, now to be considered; and each subject will furnish us with most

important practical lessons for the conservation of health. Before we enter on these subjects, however, we may briefly advert to objections which have been brought in some quarters against the *stress* laid on the blood-condition as a source of disease. We do not mean to trouble our readers with the old and new controversies between the *humoralists*, the *solidists*, and the *cellulists*, for all these have at different times entered the *lists* of medical combatants; the cellular pathology (see Virchow) being now the favourite champion. They are, we suppose, as most theological debaters are, *all right* and *all wrong*—each is right generally where he can harmonize with, and *not exclude*, the other.* Some writers are much afraid of retrograding to the humoral pathology; they will not allow that bad conditions, or impurities of the blood, are causes of disease—it is the "*organs*," they say, "which are wrong," *not* the blood. Now, in the first place, the blood is itself full of *organs*, every blood-cell being one; and again, the wrong which the other organs do, is chiefly that of deteriorating the blood;—for the function of almost all has a direct bearing on the blood—all the *chyle-making* organs

* This view is exactly that entertained, we find, by the writer we have named, Virchow (Professor of Pathology at Berlin).

Speaking of the humoralist and solidist schools, he says: "According to my apprehension, the view of each of these schools is incomplete. I do not say false, for it is false only so far as it is *exclusive* (*weil er eben nur falsch ist in seine exclusion*); it must be brought back within certain limits, and we must not forget that besides vessels and blood, besides nerves and central organs, other things exist, which are not a mere substratum for the operation of nerves and blood."—(Virchow, "Cellular-Pathologie," erste Vorlesung, p. 16—a work of great interest and merit, which we shall soon see in an *English* dress.)

for instance, and those which, like the kidneys, have to remove noxious substances *from* the blood.

Mr. Lewes proves the insignificance of blood-disorders in a curious way. He asks, "Will the blood of a child restore the worn-out organs of the old man? It is the organs which are worn out!" But the true question is (if question there could be), Will not the man who goes on making bad blood by bad digestion and assimilation, sooner find himself with worn-out organs, than the one who takes good food, has good digestion, and makes good blood;—and what kills a man in forty-eight hours when the kidneys fail to remove urea from the blood?

Mr. Lewes would say, "Yes, here you see it is the defect of an organ which kills." Another would say, "It is the *impurity in the blood.*" Of course it is both; the last, which is the immediate cause of death, being the effect of the first. But the decisive question is, Do we find that diseased conditions of blood exist? We do, and Mr. Lewes himself, a few pages after his denial of blood-disease, gives the following instance. The American physicians, Peters, Goldsmith, and Moses, found in twenty cases of persons who died from *dietetic error* (ardent spirits), that "the blood was fluid, dark, of cherry-juice appearance, *showing no tendency to coagulate*, as *healthy* blood *always does.*" Here the blood-making organs, and, consequently, the blood itself, are both injured—to say nothing of the direct effect of large doses of alcohol on the blood itself, which is indeed a *complicated organism.*

It would be neither possible nor advisable to enter into details of the various modifications of blood in dif-

ferent diseases; but the following table suffices to prove the point at issue:—

The *water* of the blood may vary from		915 to 725
The solid residue	,,	275 to 85
The fibrin	,,	10 to a trace.
The fat	,,	4 to 7-10ths.
The albumen	,,	131 to 55
The *globulin*, the material of the blood-cells.....	,,	106 to 30
The *hæmatin*, the colouring matter	,,	8 to 1
The extractive matters and salts	,,	16 to 7

SIMON'S "Animal Chemistry," vol. i. p. 246.

If the blood, then, is liable to differ so widely in the proportion of its elements, and is also liable to be poisoned, as it were, by *impurities* generated within the body or received from without, one great condition on which health depends must obviously be the maintenance of a healthy condition of the blood.

"The blood does not *make* the organs." That is true, no doubt. The organs, on the other hand, *make the blood;* but it is equally true that the blood *feeds* the organs—presents the *material* for their growth and repair. Bricks and mortar do not make a house, but the workman who builds it will not make "his wall" strong, if his bricks be *unsound*, or if he "daubs it with *untempered* mortar."

Health is maintained by each separate organism performing its office well. The *blood* is one organism, the *stomach* another, the *pancreas* another,—and each of these inter-dependent. Lastly, the material which we present

to the stomach must be well chosen; it cannot make a nitrogenous compound out of food which contains none. Chemistry is one of the helps—it is not the sole guide, of physiology; and we think the value of animal chemistry is in this light amply established, as is also the great maxim that the production of *sound* blood and *pure* blood is an essential condition of health.

CHAPTER VIII.

CIRCULATION OF THE BLOOD.

The organs concerned in it—The heart, arteries, capillaries, veins, valves, &c.—Forces which move the blood—The heart's action—Auxiliary forces, what—Circulation, how related to and promoted by nutrition—Absorption *through* moist membranes (technically called *endosmose*)—Quality of the blood as affecting its circulation—Tight clothing and ligatures, their effects in impeding circulation: dangers and fatal results therefrom—Importance of exercise in promoting circulation.

Our outline of the organs by which this process is effected, need be but very brief.

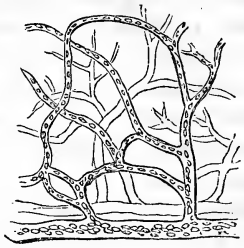
Blood is found throughout our whole body, in two distinct kinds of vessels—arteries and veins; the first conveying blood *from* the heart towards the extremities, and the second—the veins—conveying it in the opposite direction; that is, from the extremities and surface back *to* the heart. This motion of the blood may be best understood by being seen—as it may very easily be, by stretching the web of a frog's foot under the microscope. There the blood

in the veins may be seen to flow in a steady continuous stream, while that in the arteries moves by gushes or jerks, as it were, as if propelled by the successive strokes of a pump.

The heart, speaking in general terms, may be likened to the pump. It is a strong, hollow, muscular organ, consisting of two distinct sides, which have no direct communication. On one side—the right—the veins terminate, bringing back a dark-coloured blood, which has already gone the round of the body. From the left side, the arteries depart by a large trunk, which sends off branches, as it proceeds, in all directions; and these convey a fresh bright red-looking blood. Now the blood conveyed by the veins to the right side of the heart—containing also the new material, chyle and lymph—is sent at once by the contractions of that right side, through the lungs by innumerable vessels, through the thin walls of which it is submitted to the action of the air. The nature and effect of this will be considered under the head "Respiration." Returning from the lungs, the blood is received into the left side of the heart, and thence, as we have said, distributed over the whole body.

This is an outline of the *course* of the blood in its circulation. But what are the forces which maintain its movement? for we have so far spoken only of the heart; and although the regular alternate contraction and dilatation of the heart is the *chief* agent in circulation, we should err in attributing the motion of the blood to that cause alone. It is not adequate to explain all the phenomena; and other "assistant forces" have been mentioned by physiologists. Of these, some are doubt-

ful, and, even together, they leave much to be accounted for. These assistants are—1st, the *elastic walls* of the arteries (?); 2nd, the pressure of the muscles among which some of the veins run; 3rd, the movements of the walls of the chest in respiration (?); 4th, the interchange of relations between the blood and the tissues, which takes place in the capillary system during the nutritive processes.



Capillary blood-vessels, and absorbents or lymphatics (the white lines).

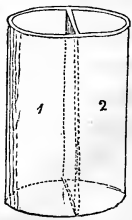
Of the first and third of these, it is not easy to see how they can promote the circulation;—this is the only doubt, for there is none as to the *facts* stated, viz. the elasticity of the arteries and the movements of the chest.

The last-mentioned process is probably a very efficient agent in the *capillary* circulation.

Dr. Draper, an American physician, is its best expositor; and as it gives an opportunity of explaining the *process* of *absorption*, we will shortly describe it.

Absorption takes place *through membranes*, and *not* through the open mouth of any tube.

Let us suppose a tube to be divided by a moist membrane into two parts; one side nearly filled with water, in which *much sugar* is dissolved (1), the other with pure water (2). In a very short time, the water in 2 would have become sweet, while that in 1 would have become less sweet—would contain less sugar than before.



The two fluids have mingled. The law of their mixture is this: the less dense liquid in 2 has passed into the side 1, while some of that in 1 has passed into 2, but not with equal rapidity—the less dense rushes into the more dense with by far the greatest rapidity. This is the general law, and forms the complete expression of it, when taken together with the observed fact that the fluids must have an affinity for the membrane, as well as each other. All fluids will not pass through all *membranes*.*

Now in the process of nutrition carried on through the capillaries, the blood in some vessels parts with some constituents, in other vessels with other constituents, and so the contents of various vessels come to be of different densities; hence those motions of various currents arise, which, while they are alternately *means* and *results* of nutrition, also help to maintain the circulation. The blood passing from the capillaries in the direction *towards* the heart, is conveyed by the veins—beginning with very minute branches, these uniting to form larger; and so on, until they reach the heart by two large trunks. To prevent the blood from retrograding, the veins are furnished with *valves*,—small membranous expansions of the lining tissue of veins,—which open freely in the direction *to* the heart. Valves are also found in the heart itself, at the mouth of some of the larger vessels; indeed, wherever they are required to prevent retrogression, or return of the blood (technically termed regurgitation) in the wrong direction.

Whatever be the benefits of the supply of blood, it is

* This process was named by its discoverer, Dutrochet, *exosmosis* and *endosmosis*.

clear that these must be diminished or suspended if the supply fails. But we know that the blood is the great sustainer of life and active power in every part, in every organ. If, then, the circulation languishes, these must all fail and languish with it. Now what are the chief causes of a defective circulation? One cause now recognized by all physiologists, is the defective *quality of the blood itself.* Of the ways in which such defect of quality may be brought about, we have already considered many, and more yet remain to be spoken of. In whatever way the blood is deteriorated, it is admitted that its defect will very much affect the regularity and perfection of its circulation. Low-conditioned blood—that which is deficient in the red corpuscles—is usually accompanied by very languid circulation; or, if the arterial action be excited to rapidity, it is still weak and unstable.

Depressing passions of the mind, too, have a powerful influence in weakening the circulation; and, as we have said already, any sudden emotion of a painful kind may throw it into disorder, or stop it altogether for a time.

We see what a word can do in calling into the cheek the flushing crimson of shame or of anger, and a scene of distress or suffering may make a strong man lose strength and consciousness in a few seconds. This is fainting, which consists in a temporary check of the heart's motions. We see at once, then, the danger of sudden shocks of the mind; of all terrifying experiments, on the young and delicate especially; and of all practical jokes which aim at sudden fright, &c. If the life and energy of every organ depend on the due supply of blood of good quality, we may understand how any pressure on the course of the blood-vessels must, by hindering this

supply, directly weaken the part whose supplies are thus cut off. Moreover, since the blood runs in a continuous circle, you cannot impede its course at any part without so far interfering with the whole; although nature has provided, to a certain extent, for this danger by innumerable communications, or cross-junctions we may call them, at various points (*anastomoses* the anatomist calls them).

Another evil arising from checks to the circulation in any part is this, that not only is the supply diminished, but the quality injured too; for it is well known that blood never long retains its good condition when its *motion is suspended.*

It undergoes a rapid change for the worse wherever it becomes stagnant; so that the popular idea of the evil arising from a stagnation of blood anywhere is not far wrong.

We may now see the immense evil arising from *all ligatures*, and from tight clothing of every kind. The author has himself known instances of all but fatal hæmorrhage (many *quarts* of blood having been lost) from the swollen veins having burst, the whole evil having been caused by tight ligatures, as garters, &c. Yet we daily see persons with obstruction of the veins, brought on in this way, persisting in the very abuse which has caused the evil—from want of thought or of due knowledge of the process of circulation.

The greater part of the difficulties of the circulation are so dependent on the observance of the rules already deduced from the laws of the animal economy, that they are within our own power to remove, or at least to avoid. There are some other disorders, both of the

blood-vessels, heart, or blood itself, which depend on other causes, and require other treatment. But the most of even organic diseases — for example, most of the organic diseases of the heart itself—arise from these three causes:—1. Errors and intemperance in food or drink, causing *degenerations*, as they are technically called. 2. Rheumatism, induced by imprudent management when exposed to cold and wet. 3. Mental anxieties and *griefs*. Very frequently two or all of these combine. The first cause we may entirely avoid; the second to a considerable extent; and the third would have less effect, perhaps, if it found no allies in the other two.

The importance of due and regular exercise to the perfect circulation of the blood we shall consider in the next chapter, on Respiration.

CHAPTER IX.

RESPIRATION.

Its importance in maintaining sound condition of the blood—The air we breathe—Its physical qualities—Its chemical components—The organs by which we breathe—They require free motion, and are hindered in their action by all tight clothing, stays, &c. &c.—Effects of burning and of repeated breathing in exhausting oxygen and saturating the air with carbonic acid gas—Dangers of crowded rooms—Evils of close bedrooms—Fatal results of burning charcoal, coke, &c. in close rooms—Choice of habitation in pure air—Ventilation of houses, cities, &c. &c.

Under this head we have to call the reader's attention to another cause of defective blood, viz. defective respi-

ration, which plays a very great part in producing debility, and ultimately disease. To understand this, we must consider what respiration is; and it is necessary to observe that the blood not only gives the materials of organic life to every part, but that it receives and carries back with it the used-up particles, the waste material as it were, which results from the wear and tear of the living organs. The blood, as it returns from its mission, is in a very different state from that in which it sets out. It is charged with impurities which it has to get rid of; and this is one great object of the airing which it gets in passing through the lungs. We have seen that the new material of blood requires this exposure to air before it is fitted to assimilate with the mass of blood; and so likewise does the old blood, which has already done one round of its work, require readjusting, as it were, before it is fit to take another round.

This, then, is the office of respiration. It consists essentially in the contact of air with the minute blood-vessels, and through their coats or membranes with the blood itself.

Let us first inquire *what* is this air which we breathe, and without which we cannot exist in life even for a few minutes, and why are we unable to dispense with it even for a short time?

The air in which we live surrounds our earth to the extent of from forty to fifty miles in all directions; and as it has weight, it presses on every part of our body (to the extent of some thousands of pounds on the whole); yet we are not sensible of that pressure, for it is equal on all sides, and the air is also elastic; but if the pressure be withdrawn partially, that is, from some small extent of

surface, the sense of pressure on the immediately surrounding parts becomes at once intolerable. This may be easily verified by exhausting a cupping-glass, or a common teacup, and applying it quickly to the palm of the hand.

The varying *amount* of pressure of the air from its various states of rarefaction, has much to do with our sensations, both in the state of health and of disease; this is what is meant by feeling changes of weather in a tender part—a corn, a bruise, &c.—but we need not dwell on this: the chemical composition of the air is what chiefly concerns us. Air then consists, in 100 parts, of about 80 nitrogen to 20 of oxygen gas. The act of breathing is performed in an adult healthy person, at rest, about 16 to 20 times per minute, and at each inspiration a portion of the air always existing in the lungs is renewed, while the air already used is at each expiration discharged.

Now this alternate expansion and contraction of the lungs is brought about by the muscular action of the hollow framework, the chest, in which the yare lodged. It is not the lungs which move, and so alternately raise and depress the walls of the chest—but the chest itself is the moving body, and then the elastic air is drawn in, as it were, by this motion, and so distends the lungs.

That this is so will at once appear, when the structure of the lungs is compared with that of the chest. The lungs are formed by the division of branches from the windpipe into innumerable small tubes, terminating in small distinct cells of a very delicate structure, the surface of which is lined with the minute capillary blood-vessels.

This structure is elastic and contractile, but has no proper motion of its own. On the other hand, the walls of the chest are a framework of bones and cartilages—in many pieces—as the ribs, breast-bone, &c., and to these are attached powerful muscles, so that we can raise them at will to a great extent (although *usually* without any act of the attention, this muscular action being carried on even during sleep). While the ribs, then, are raised and expanded by this action, another muscle, the diaphragm or midriff, situated transversely between the chest and the bowels (forming a barrier between them), by its contraction pushes down the bowels, and so *lengthens* the cavity of the chest from above downwards. By these two motions combined, the pressure of the air on the inside of the chest and lungs which line it, becomes less in comparison with that on the outside for a moment, and the elastic air rushes in to equalize the pressure. This is the *inspiration;* and then, when the muscular action which has caused this movement is for a moment relaxed, the elasticity of the chest itself, and that of the lungs which had been overcome, prevails again, and the lungs contracting, the air is again expelled. This is *expiration.*

The full effect of this process, then, we see, cannot be attained, if by any means the *free motion,* both of the chest itself, and of the abdominal walls below the chest, be impeded. What, then, must the evil results be of such modes of dress as impede either one of these actions?—and but too often, by the pressure of stays and other evil contrivances, both actions are impeded at the same time. The chest can neither expand at the sides nor yet from above downwards (or vertically), and it is probable that the act of respiration is only half performed.

We may be better prepared to appreciate the importance of the process of respiration, and the consequent amount of evil such hindrances must inflict, when we have learned what changes in the blood are effected by this function.

The blood which is sent to the lungs we have seen is of a *dark* colour, and the chemist tells us that it is charged with a larger amount of carbon than the other kind of blood is. The air which is taken into the lungs is, we find, a compound of only two gases—oxygen and nitrogen (very small amounts of other elements only excepted); but that which is discharged *from* the lungs by expiration is found to contain a large proportion of carbonic acid gas, which consists of oxygen united with carbon. This dark venous blood thus absorbs the oxygen of the air, while it throws off the carbonic acid with which it is charged, and the blood, as it is returned from the lungs to the heart, is of a bright red, and such as is fitted to sustain life. Now, what is the effect of suspending this process for two or three minutes?—It is this, that the dark carbonaceous blood, *un*changed, is then sent back to the heart; by the heart it is urged into the brain; and no sooner does the brain feel the access of this blood than it becomes, as it were, paralyzed in its vital actions. Sense and consciousness are gone, thought is in a moment extinguished; in short, "*animation is suspended*," and without a speedy introduction of air into the lungs, life will be finally destroyed.

Just, or nearly, the same result is produced by attempting to breathe *in* carbonic acid gas, as when persons are shut up in a close room where charcoal (carbon) is burned, *i.e.* united with oxygen, and carbonic acid gas

thus formed. The carbonic acid gas thrown off by the lungs by the ordinary process of respiration would produce the same effect, if retained in the blood instead of being expelled, or if reintroduced after being expelled; and this is actually the case in instances where too large a number of persons are shut up in a small space of air. The air soon becomes charged with a large proportion of carbonic acid gas: this produces a feeling of distress only to be imagined by those who have felt it; and if the same air, without renewal, is still breathed again and again, death ensues.

It ought to be known that air is rendered unfit for breathing by two distinct processes: one, which deprives it of its oxygen, as *all* combustion does, burning as well as breathing; another, which allows hurtful gases to mingle with it. The usual source of mischief in crowded rooms, and where due ventilation has not been provided, is the *substitution* for pure air of a large amount of carbonic acid gas, discharged from the lungs of the multitude; and when the air becomes *charged* with the carbonic acid, its capacity to receive more is lost,—it can no longer be thrown off from the lungs.

In the process of burning charcoal, coke, &c., carbonic acid is always produced, and, if allowed to accumulate in a close chamber, it would be speedily fatal; but, moreover, if this carbonic acid so produced passes over, as it easily may in such circumstances, red-hot charcoal or red-hot metal, it is deprived of some of its oxygen, and is converted into carbonic oxide, a still more pernicious gas. The danger, therefore, of such a process is apparent.

It is estimated that about ten ounces of carbon are removed from the blood by respiration in twenty-four

hours; and we may judge of the result, if that state of blood which we may term the carbonized *prevails*.

This it may do either in consequence of an imperfect supply of fresh air, as when we sleep with closed doors and windows, and in small rooms, or when the act of respiration is imperfectly performed at all times, owing to pressure on the breathing organs. Yet we still find persons not content with closing doors and windows in bedrooms, one or other of which may generally be left open with great advantage; but if there happen to be a chimney which might admit a little air to their relief, this also is most carefully stopped.

And still (though not to the extent we once saw it) do we see the breathing organs of young women allowed as little motion as possible; while the benefits of *free* exercise, by which, if the *stays* were discarded, the force and frequency of respiration would be greatly promoted, are too much neglected, especially in boarding schools.

This poisoned condition of the blood, then, from defective respiration, is another fertile cause of debility; for just that is retained in the blood which, we know, if only increased to a certain amount, would deprive us entirely of motion or sense.

We do not go about directly to commit actual suicide in this way. We only render ourselves weak, helpless, miserable; and this we may do if we will. No sanitary law can hinder us from inflicting all this on ourselves, although, so far as our knowledge goes, some pains are now taken to prevent our inflicting health-destruction on others. No doubt all this is done, not wilfully, but for want of thought or of due information.

That we may get the full benefit of the depurative or

cleansing process of respiration, it is therefore needful that we allow the muscular action to go on without hindrance,—that we excite it to a sufficient amount by labour or exercise,—and that we *take care of our ventilation;* in other words, introduce sufficient supplies of fresh air. Yet the air we do so introduce into our apartments, or breathe when we are abroad, may be itself very impure. The causes of such impurity may some of them be within our control, the others may fall under the head of public sanitary laws. We should, after having taken care to avoid close sleeping-rooms, crowded assembly-rooms, &c., place ourselves in the best position with regard to the general air which surrounds us; and this is so obvious, and so much acted on, that it is scarcely needful to urge it. We instinctively choose our habitation in the most airy quarters. We prefer Bayswater and Maida Hill to Soho or Fleet Street. We lend our individual, or, if we have it, parliamentary voice and influence, to all schemes for ventilating London, increasing the efficiency of its lungs, the parks,—for cleansing the Thames and the Serpentine, &c. &c.; but one ought not to forget that these patriotic efforts should lead us to set a good example at home, in seeing that our drains and sewers are all right, that none of them are exhaling into our own dwellings a pestilent air.

Lastly, let me observe, that in many dwellings much evil arises from the imperfect condition of a small but needful apartment, which, when neglected, may be a source of withering corruption.

As to public sanitary laws, they scarcely fall within the scope of this work, and on these matters sufficient information is continually furnished; the only thing to

be desired is, that we should be able, with less circumlocution, to come to our work as men who know what is required, which is—the money to do it.

CHAPTER X.

THE SKIN.

Importance of its functions to health—Matter perspired—Organs—Extent of perspiratory tubes—Disease arises from the partial, death from the entire, suppression of functions of the skin—Skin-culture, what it is—Baths explained—Temperature—Rules for bathing—Friction, shampooing, &c.—Skin diseases dependent on general health and condition of blood.

THERE is another channel through which a constant purifying process is kept up for the purpose of maintaining our blood in a perfect condition. This channel is the Skin, in which *twenty-eight miles* of drain-pipe is laid, according to Erasmus Wilson, and through which it is computed that about two and a half pounds weight is exhaled during the day.—(Kirke's "Physiol.," page 353.) The greater part of this is water; but carbonic acid, urea, ammonia, lactic acid, &c., form a part of it. Whatever differences of computation exist as to the amount and respective proportion of these different substances thrown off, one fact is most certainly proved by experiment, viz. that this action of the skin is most important, even indispensable; for if an animal's skin be coated with varnish, or carefully packed in a waterproof material, so as to render perspiration impossible, *the*

animal speedily dies. Now, when we neglect to keep the skin clean, either by bathing or hard work, or, best, by a combination of both, we permit the *gradual* formation of a kind of natural varnish on our skin, by which, in no long time, the perspiratory process is almost annihilated. In short, we stop the pores of the skin, and choke the twenty-eight miles of drain-pipe, either partially or wholly; and this silent process, the result of mere negligence, is the cause of a large amount of chronic disease, and the destruction annually of thousands of lives. Soap, water, strong exercise, and friction of the skin by Russia towels, brushes, and hair gloves, are the obvious remedies.

The great facilities now rendered to the inhabitants of London, of every grade, for this care of the skin, in public baths, &c., is an immense boon. We cannot recommend in too strong terms that the privilege should be more and more extensively used.

Our Saxon cousins have a distinct term for their care of the skin-functions,—"haut-*kultur*" (skin-culture); and the *maintenance of the drainage* in good working order is even more important to success in this process than it is to our success in agriculture.

The reader may be curious to know by what process of reckoning Mr. Wilson arrives at the conclusion that our surface-drainage for the whole body reaches so large a figure as *twenty-eight* miles. The eye requires but small assistance from art to enable us to count the number of pores or *openings* of perspiration-tubes in the skin. Mr. Wilson says that "2,800 may be taken as the fair average of the number of pores in the square inch, the tubes themselves being taken at each a quarter of an inch long:

this gives 700 inches of tube to every square inch of our body. The number of square inches of surface in a man of ordinary stature is about 2,500; the number of pores therefore 7,000,000, and the number of inches of perspiratory tube 1,750,000, that is, 145,833 feet, or 48,600 yards, nearly 28 miles." We may infer that such an extensive apparatus *must* have a great purpose to serve, and we have seen that life is destroyed by its total obstruction. What less, then, *can* result from every *partial* obstruction of it than disease and weakness?

Among the chief means of maintaining the functions of the skin in perfect order, we have mentioned baths and friction, and both these subjects are so important as to demand separate consideration.

Ablution, or the cleansing the skin by the use of water, has been deemed so important by almost all nations as to be enjoined by public law, and often as a religious duty. It is so now in the Eastern world; and there yet remain of the ruins of antiquity enough to show to what extent this practice was carried, for it was esteemed a necessity, and not merely a luxury. The common distinction of baths is into cold, warm (or tepid), and hot, and the hot is again distinguished, according to the means employed, whether water or its vapour.

There are, besides, hosts of medicated baths, and various devices for the application, as in a shower-bath, and the endless contrivances for the vapour-bath. There are also hot-air baths, &c. We shall speak only of those most useful as a means of *preserving* health, for the application of baths to states of disease is a matter that requires the greatest circumspection, and cannot

be regulated without medical advice taken on each particular case.

The following table exhibits the temperature of the various baths.

——	Water.	Vapour.	
		Not breathed.	Breathed.
Tepid Bath ..	85° to 92°	96° to 106°	90° to 100°
Warm ditto ..	92 „ 98	106 „ 120	100 „ 110
Hot ditto..	98 „ 106	120 „ 160	111 „ 130

For purposes of *cleansing* the skin, the tepid bath is obviously most applicable; because the warm water, assisted by a free use of soap, will of course dissolve and remove impurities for which cold water would not suffice. A bath, at about 94°, may be generally advised for this purpose.

But to some, cold water may be recommended for its power of producing strong reaction, and of rousing the energies of the nervous system. The cold bath can only be used by those who have sufficient re-active powers to produce a rapid and healthy glow over the whole frame. This is the best test of its benefits. In cases where coldness, low or weak circulation, or headache, follows its use, it ought to be abandoned as worse than useless. The choice of a cold bath usually lies between the shower and the plunging bath, for the *douche* is applicable only in exceptional cases. The plunge-bath is, I believe, preferable to any, where it can be conveniently had; of

course, the plunge is to be taken head downward, taking care that there is sufficient depth to admit of this being done without danger. Where circumstances do not admit of the plunge, the shower-bath answers well, and has the great convenience that it may be used in one's own chamber.

It cannot be used, however, in cases of *great* debility, and its employment, under any circumstances, must be strictly subject to the rule above given. Severe headaches and still worse consequences have resulted from the neglect of this rule.

Friction.—Closely allied to the bath is the use of friction, for it usually and most conveniently follows it; but I quite agree with Mr. E. Wilson, that some of the old forms of horsehair glove were more adapted for the currying of a horse than for application to the human skin.

Russia duck towels, of various sizes and shape, and a good brush, or better two—one with a long handle, and the other with a strap across the back, into which the hand can be inserted, answer well; and these should be of about the stiffness of the ordinary hat-brush.

And this is a matter of more moment than at first appears; for if the brush be too harsh, the friction cannot be maintained with any force or for a sufficient time (the skin would be quickly removed if it were so used), and in this way the benefit of friction is almost entirely lost. If there is any part of the body, or any joint in the limbs in which any peculiar uneasiness or weakness prevails, the infirm part ought to receive *a double portion of our care*, and a double amount of brushing in that quarter will repay our trouble tenfold.

No one who has not witnessed it himself would believe the extraordinary benefit which may be realized in this way. This, indeed, is the chief secret of many irregular, but very successful, practitioners of the present day, who boast, and *sometimes truly*, that they cure ailments which have been "given up by the faculty," &c.: but why should not the faculty (some of them do) put in force the same means; and why should not every man take the same pains to preserve his health and activity, or to *regain it* when it is yet time, by the persevering use of these means? Every one has heard of the mysteries of shampooing, and other like practices, the whole *real* efficiency of which may be expressed in two words—"friction and pressure," only used with varying degrees of force, and with the due regularity and perseverance.

In connection with the functions of the skin, we may just mention the modern notion that most skin diseases depend on the presence of parasitic animalcules.

How far this is the case or not is at this moment a subject of controversy in the medical world, and we cannot weary the reader with the arguments *pro* and *con.*; but it is more to our purpose to show that the all-important condition of their cure is the preservation of the *general health*, in conjunction with care of the skin, which, as we have shown, has no small share in this matter. We need only cite two authorities.

Mr. Hogg (in the "British Medical Journal") states, "that while these diseases are rarely, if ever, cured by destroying the parasite, they *can* be cured by appropriate alteratives and tonics, which are capable of correcting the *blood dyscrasia*" (which may be Englished *bad condition* of the blood).

Again, Mr. Hunt says: "We must not rely on local applications to effect the cure, or even to arrest the disease, without at the same time endeavouring to procure a *blood-change;*" so that it appears that the old popular idea of these things originating in impurity of the blood, is not so far wrong after all.

At all events, the weight of all medical authority points to the necessity of that regulation of diet and regimen which tends to make good blood, on which we have so much insisted.

CHAPTER XI.

CLOTHING.

Its use not to produce but to *retain* heat, to prevent its abstraction by the air—Adaptation of clothing to circumstances and to periods of life—Popular errors as to clothing infants—*Both* extremes of life require abundant clothing—Regulation of temperature—How to guard against effects of extreme changes of temperature—Use and abuse of water-proof clothing—Clothing as a protection *against sun-heat.*

In considering the office of the skin, we must not pass over the subject of clothing, for it is one purpose of clothing to preserve the activity of the skin, although it is not the only purpose.

We have already adverted to the production of animal heat, and to the necessity for equalizing this production with the demand made on it by the continued abstraction of heat, through the medium of the air. In our climate,

the temperature of the air is almost always far below that of our bodies. The air is also charged with moisture; it then abstracts heat more quickly; and when in damp and rainy weather we also get our clothing wet, the evaporation which goes on from the surface, wastes our warmth rapidly. There is then a double object in clothing; 1st, to *retain* the heat we produce, by interposing a non-conductor between us and the air; and 2nd, to prevent the access of wet to our skin, and consequent evaporation. And here a difficulty presents itself; for the same material (waterproof articles of various kinds) which would effectually prevent rain from penetrating to our under-clothing, prevents, almost as effectually, the natural transpiration of watery vapour. On this account, no medical man can sanction their use, unless to a very restricted degree. When used at all, all these articles of dress should be made very large and loose, as they usually are, and they should not be worn during strong exercise. Under any restriction, however, I am inclined to think their use objectionable. The very best material—that which fulfils every condition the best, as a non-conductor of heat and a repellant of rain—is the material of which the true Scotch plaid is made. It is also recommendable on account of its lightness and its durability.

The chief use of linen and cotton dress is, that it should be worn next the skin. Even here I am inclined to think woollen articles of dress, so prepared as to wash well, are preferable when changed frequently.

As to amount of clothing, we must never forget that a certain access of *air* to the skin is an important condition of health; also, that *too* great action of the skin or perspiration may be induced, and such an amount of waste

encouraged as to make too serious demands on the supplying power of the nutrient organs.

Hence, the evil of over-clothing will be apparent on both these grounds; and it should be our endeavour, by attention to the results of experience, to ascertain what is to us too little or too much. No such rule can of course be laid down to suit all cases; but in general it may be stated, that our own sensations of comfort or discomfort will usually point out the amount of clothing we do require.

It should be remembered that the very young and the very old require warmer clothing than those in middle life; and the neglect of this rule, at both extremes of life, is the cause of many premature deaths. For children, it may be strongly urged, it is more safe to send them out of doors in all ordinary weather, thoroughly well protected by warm clothing, than it is to dress them in scant theatrical costume, and to choose only now and then a day for their out-of-door exhibition. With regard to very young infants, there are some exceptional states of weather in which it would not be right to expose them at all to open air—as, for instance, very sharp north-east wind, with a low temperature: they may be aired sufficiently under the roof.

There are some mistakes made as to the risks of wet clothing. On the one hand, you find even strong active people with a nervous horror of getting wet, which is quite unfounded. They have only, in such a case, to keep up vigorous exercise, and they are not only safe, but may be even the better for it. On the other hand, you may find persons even of tender health say, "I am only wet on the surface, I need not change before I sit down to

rest." This is a real source of danger; although they are not wet through, the *evaporation* from the wet surface will soon induce dangerous chill. Keep up strong exertion while wet; change ere you rest. This is the golden rule.

Before we quit the subject of clothing, we may mention one of its uses—which, however, is more applicable to tropical climates than to our own—that is, its use to ward off the direct action of the sun; and the same non-conducting substance which is used to retain heat generated within, is evidently calculated to keep off that which comes from without. The only thing to be said is, that clothing intended for such a purpose, should be of light colour—white, or nearly so: this is well known, and scarcely requires mention. It is perhaps more needful to say, that all coverings for the head during extreme heat, ought, if they are composed of thin light materials, to be lined with some non-conducting substance—as layers of muslin, two or three times doubled—or they will not sufficiently protect the head. This ought especially to be observed in the head-dress of children, who are very liable to serious affections of the brain from neglect in this matter, when they are exposed to a powerful sun.

It is yet more necessary to give some cautions as to exposure to the other extreme—that of intense cold—owing to popular mistakes, prevalent on this point.

The thing most feared is that in which there is no danger at all—that is, transition from great heat to great cold. Of course additional clothing *is* required when we make the exchange; *that* is needed to retain the heat we have, that we may part with it gradually: but the hotter we are when we make the transition, the better; for we

have a better stock of heat to go on, and can afford to lose the more. It is an error to suppose that the danger of the transition depends on the contrast, and that, therefore, the *colder* we are when we step out of our house on a severe winter night, the better we shall bear it—the difference or contrast being less. Need we tell the oft-told tale, how the Russians come reeking hot out of their vapour-bath, and plunge into snow instantly, and this as a healthful luxury.

The application of this dread of contrast in temperature ought to be made to a case little thought of, viz. that of passing from a very low temperature to that of a hot room, or, still worse, to receive the direct radiation from a blazing fire. This, indeed, *is* highly injurious; and the worst effect on the lungs—bronchial disorders of serious import and long duration — (if they do not at once prove fatal)—have been induced by a few minutes' imprudence of this kind. A *moderate temperature*, warm drinks, a cup of hot coffee or tea, should be resorted to on entering the house after exposure to intense cold. And, of course, as is well known, any external part of the body which is frost-bitten, or, short of this, has been seriously benumbed by cold, should be treated on exactly the same principles—that is, *friction* with snow or *cool* water, any sudden application of *external* heat being most certainly hurtful.

The skin, when in a healthy condition, is admirably adapted to be a *regulator* of our temperature; for when we are exposed to great heat, it soon becomes damp from perspiration, and the evaporation of this moisture quickly lowers our temperature.

It is only in this way that we can explain the facts (no

less true than strange) of persons having encountered an artificial heat of near 400° for a short time.

The workmen in our glass-houses, &c., though not exposed to so high a temperature as this by much, yet are *constantly exposed* to such heat as must be intolerable, but for this provision of nature. On the other hand, in very cold weather the skin is dry, and then, in conjunction with the other tissues which lie immediately beneath it, we have a covering of no small efficacy as a non-conductor: were this not so, the face and other parts exposed to air, would be constantly frost-bitten, even in our own climate.

When we wish, then, to cool the skin, which we may almost always safely do, even in fevers, provided the heat has already reached a high degree, we have but to moisten it. Sometimes water quite cold may be used, and even suddenly and copiously affused; but sponging with tepid water (with or without the addition of a little vinegar) also produces by its evaporation a most soothing and beneficial effect.

So promptly reviving, indeed, is this process, when appropriately used, that we can scarcely attribute its effects to the mere lowering of the temperature; there can be little doubt, that it produces other vital changes in the capillary vessels and the nerves on the surface of the body.

CHAPTER XII.

EXCRETIONS BY THE KIDNEYS AND INTESTINES.

Importance of good digestion to the regular action of the bowels—Adaptation of diet, regimen, &c. to the relief of habitual constipation, or to the other extreme, diarrhœa—*Kidneys*—Importance of their function to health—Disorders arising from its perversion—Its entire suppression fatal—Causes of diseases of kidney—Cautions as to their insidious approach—Difficulty of their cure—Means of preventing them—Influence of diet and regimen on them—Bright's disease—Diabetes, &c., how caused, how prevented.

From the continued change of matter which is going on in every part of the body, it follows that there must be a constant discharge of waste, as well as a corresponding introduction of fresh materials. And it is clear that the introduction of fresh matter, and the attending renewal of vital action, can only be measured by the waste which occurs. All the functions of life run in a circle, so that the diminution of waste and of excretion, which is the casting off of effete particles (such as have done their work, and come back into the purely chemical world of dead and decaying matter), implies a diminution of vital action. It has this result, certainly; but it has another. These dead matters are in the way, and they are hurtful; they are, as it were, poisons in the blood; and this fluid cannot regain its wholesome condition unless this defect of excretion be remedied. We have spoken of the lungs,

and skin, and liver, as depurative of the blood—that is, as removing something which is noxious if retained: there are other excretions now to be considered, which are chiefly those thrown off by the intestines and the kidneys.

The first requisite for the regular performance of this function of the intestines is the perfect fulfilment of digestion in all its stages; for, as we have seen that habitual looseness of the bowels is the result of one form of bad digestion and imperfect absorption, so is constipation—one of the most prevalent of our ailments—the effect of other disorders of the digestive function.

Another cause is the too great delicacy and refinement of our diet. A certain degree of coarseness in our diet is really necessary, for two reasons—we require bulk in our food as well as nutrient elements; and this holds good in feeding the domestic animals. A horse will not thrive on oats alone, however nutritious they may be; he must have chaff or hay, or both.*

Again, the nutrient elements may be advantageously mixed with others which are quite indigestible, and which are only fit to be expelled; but these serve to stimulate the various secretions of the surface, and also to promote the muscular action of the whole alimentary canal; and this is of great importance on many accounts. In relation to the evil we are considering—constipation, it is all-important.

Due action of the liver is an important requisite for the promotion of the action of the lower or large in-

* Horses, when fed exclusively on oats, have been known to gnaw the wood of their manger, endeavouring, instinctively, to qualify their too concentrated diet.

testines. This, and the peristaltic action of the bowels themselves, are promoted by nearly the same conditions; which are chiefly active exercise, temperate feeding, and abstinence, or at least great moderation in the use of all fermented drinks.

There is one other condition, and that is quietness of mind and moderation in all mental labours; in other words, a healthful brain. This last consideration, however, falls under our next chapter, on the nervous system, as the balancing power of the whole living machinery.

The use of brown instead of white wheaten bread is a well-known popular remedy for constipation, and in many cases is most useful. It has this great advantage, that it is in itself more nutritious than the whiter bread; whereas some other remedies for constipation not only do not nourish, but *disturb* the function of digestion to a great degree. In almost all cases, this remedy, seconded by the use of fruits, succulent vegetables—honey where it agrees—will suffice to remove the difficulty, except when it arises from *nervous causes*, and then they will be unavailing. This case belongs, as we have said, to another head, and will be there considered in its proper place.

Where medicine cannot be dispensed with, one of the best is a combination of rhubarb with the bitter extract of taraxacum (dandelion).

The Kidneys.—The function of the kidneys seems to be entirely one of excretion. Unlike the liver, its products serve no purpose in the economy, but are to be expelled entirely. Its office is to remove from the blood certain elements which are hurtful if retained; and how important it is, we may perceive from the fact that dis-

order always follows any partial defect in its exercise, and death very quickly ensues on its entire suppression.

Urine.—The quantity of urine passed in twenty-four hours in a state of average health is regulated almost entirely by two circumstances—the amount of drink on the one hand, and that of the perspiration on the other. In very hot weather it is no uncommon thing with those who perspire freely to find the amount of urine reduced to a very few ounces; and with this circumstance is connected another, which, when unexplained, has often occasioned needless alarm. The large amount of perspiration diminishes the amount of *water* discharged in the form of urine, but it does not lessen, excepting slightly, the amount of solid substances, or that of the colouring matter; so that these, being so very little diluted, give a high colour, amounting in some cases almost to blood-red, to the urine. And if the attention happens to be directed to this unusual appearance, it is immediately inferred that there must be some sudden, and perhaps dangerous disease of the kidneys to account for it; but when the cause of this phenomenon is explained, and it is known that it occurs to persons in quite good health, the alarm is seen to be entirely groundless.

Every one must have observed that when urine is passed soon after drinking water, tea, or other weak liquids, it is quite pale; on the other hand, that which is passed a few hours after dinner is of a deeper colour, and usually not so abundant. This seems to be the product of digestion; and this leads me to observe that, in fact, the greater part of the changes and distinctions observable in the urine (excepting that dependent on the mere balance of quantity between the perspiration and drink,

and the consequent degree of *dilution*), are to be traced to the digestive system, that is, to differences of diet or different states of the digestive organs. Indeed, by far the greater part of the worst diseases of the kidneys are referrible to the same source.

It is true that sometimes the immediate exciting cause appears to be of another kind. We often hear of exposure to wet and cold bringing on disease of the kidneys of an acute and even fatal character. Sometimes a shock, as in hunting, leaping, &c., or a long journey, may be accused; but in almost all these instances the foundation was laid before, in a bad state of the blood, induced by defects in the process of nutrition, and these again attributable too often to errors or intemperance in food and drink, or to moral causes.

To enter into details of the physiology or pathology of urine would be out of place and useless in a work of this kind; but a few instances may be given of the more common disorders of this function, and the means of preventing them. This is a matter of the utmost practical importance; and there is no class of disorders, perhaps, in which it is more needful that the patient should have an understanding of their origin and early stages; for this plain reason, that for the most part the physician hears nothing of them until long after these early stages are past, and when it is usually too late to remedy them. Their prevention is almost entirely within the power of the patient; for they arise generally from palpable violation of the laws of health.

The most common complaint which we hear of connected with the urine, is gravel: there is some uneasiness in the act of voiding it; we have some pains about the

loins; if the gravel takes the form of stone, or of concretions of any size, the pain is sometimes very severe. On cooling, the urine deposits a sediment of some kind, and we are aware that something is wrong in this quarter; but what we are not aware of is, that the causes of this state of things are usually quite remote from the kidneys.

Various kinds of stone, of gravel, &c., are known. The two *most* common are—

1st. Where the urine is high-coloured, and deposits a reddish brickdust-coloured sand; this is called the *lithic* acid deposit, and it is the most frequently met with.

The 2nd is where the urine is pale *opalescent*, or whey-like, and the deposit of a dirty white (this kind of urine becomes more turbid by boiling, or by the addition to it of a little ammonia). This sort of gravel is called *phosphatic*, because it consists chiefly of phosphate of lime and phosphate of magnesia and ammonia.

Let us now consider the causes of these two kinds of gravel.

1st. The lithic acid, or red gravel.

This is usually induced by taking a larger amount of animal diet than we can either digest or require; by indolence, and consequent inaction of the skin; and the following authentic anecdote, which I give on the authority of an eminent French physician, M. Andral, is a good illustration of its nature. He relates that a rich merchant in Paris was afflicted with the first form of gravel which we have described, and as he continued to live as the rich usually do, his medical friends did not succeed in curing him. But the revolution broke out—that of 1789, and in its vicissitudes he lost all his fortune,

and was reduced to labour for his bread. In no long time he completely got rid of his painful disorder. After a time, however, another change in the state of parties restored him to wealth and his former position; the restoration of his fortune, however, brought with it a return of his disease, which he did not get rid of until another reverse brought him to poverty.

The lesson here is obvious. A moderate diet, especially as regards animal food, and habits of active exertion, are no less needful than medicine for the relief of this form of disorder; and this mode of treatment exactly accords with what has been said of the influence of various articles of diet.

Much animal food tends to produce an acid condition of blood and of all the secretions. Vegetable diet, fruits, &c., tend to correct this. Accordingly, we find the urine of the carnivorous animals highly acid, while that of herbivorous animals is of an alkaline character. Now, the morbid product in this form of gravel is of an acid nature, and the condition of the urine is much more acid than in the state of health. The remedy, therefore, is obvious.

Again, much acid is carried off from the blood by the skin when we perspire freely: hence the value of this means of relief; and the very best mode of keeping up perspiration is by active exercise.

The other form of gravel seems to be usually connected with a low condition, and is sometimes brought on by over-work, more particularly head-work, anxiety, close attention to business: these are all exhausting influences, and the nervous power in such cases is wasted at a greater rate than the digestive powers will supply. The remedy, therefore, must be to avoid all these causes of

exhaustion, and to restore the nervous system by making the most of the digestive powers. Tonic medicines of various kinds are indicated, and a restorative diet, with a moderate supply of animal food, but no more than the weak stomach can digest; if, aided by a little good wine, it can digest better, this help should not be denied; and as a supplementary aid, the importance of good bread is here most obvious, the brown bread being in every respect preferable. Repose of body and mind, change of air and scene, are also indispensable in severe cases.

There is yet another form of disease manifested in the urine, whose origin, however, must be referred almost entirely to disorders of the nutritive organs. It is that in which the urine contains albuminous matter. Such urine is usually pale, though not always; and it is known to contain albumen by its coagulation on boiling it, or adding nitric acid to it.

If we exclude the acute cases of this disease, such, for instance, as come on after scarlet fever (and these even are connected with that inflammatory condition first established in the alimentary canal), but if we look only at the usual chronic form of this disease, commonly known as Bright's disease, we shall be borne out by the concurrent authority of all the best writers in attributing its origin to previous disorders of the nutritive and assimilating functions. Intemperance in food and drink is the cause in very many instances; defective digestion, from this and other causes, a badly-ordered diet, foul air, &c., all concurring, perhaps, to produce bad blood, lay the foundation for this disease; and all this is going on, probably, not for weeks and months, but for years. It is only when daily increasing weakness, dropsical swelling,

difficult breathing, palpitations, &c.—the usual symptoms of the last stage—occur, that the aid of the physician is sought, and then it is too often unavailing.

If I may express the plain truth in a paradox, *prevention* is the *only cure* for this formidable malady. In the early stages, it is within the power of the patient to avert it by correcting the errors of management to which it is attributable; and this can only be accomplished by strict temperance in food and drink, by regular exercise, and by such *choice* of diet as may prevent the accumulation of those elements which serve to encourage the formation of superfluous fat. Such are the articles belonging to the class, the heat-producing, those *not* containing nitrogen, as the starch and sugar compounds and fermented liquors, particularly strong malt liquors and spirits. All these, if supplied beyond the real demands of the system, and not quickly removed by the vital actions attending a laborious life, are readily converted into *unwholesome fat;* and this, in fact, is found in most cases of the chronic form of disease now under consideration, to give the anatomical character to the diseased kidney. When examined after death, it is very generally found to be what is technically called a *fatty degeneration.*

Indeed, long before any disease of kidneys is suspected by the patient, its approach may often be guessed by the experienced observer when he sees an ominous combination of weakness and fat, gradually and stealthily increasing. If, at this time, warning be given, and *duly taken,* there may be *some* hope of warding off the fatal issue; but it can be realized only by a total and resolute change of habits.

There is still another disorder connected with the kidneys—not so common as the former, yet equally serious. I refer to diabetes, the chief character of which is the excretion of a considerable amount of sugar in the urine.

In this case, also, the disorder comes on very insidiously, and often exists long before any medical aid is sought. The patient is at length induced to obtain such aid by the weakness and emaciation which he finds daily increasing, but is still quite unaware of the cause.

This is revealed only when chemical examination of the urine has confirmed the suspicion induced by the symptoms, in the mind of his medical adviser.

This disorder also originates in the digestive system, and like phthisis—to which it seems nearly related—is probably owing to a weak and diseased condition of the absorbing surface of the intestines, which, although the least cared for, is really one of the most important parts of our organization, being the very *root* (as we must repeat) of the vegetative life.

We call the reader's attention to this subject for two reasons; that the disease may be recognized in its earlier stages, since it is hard to cure in its more advanced, and also because, where there is a tendency to the disease, much may be done for its prevention by proper regimen and by a correct choice of diet.

The causes of diabetes are such as weaken the digestive organs, through exhaustion of the nervous power.

Inordinate fatigue, anxiety of mind, exhausting indulgences, and the influence of a hot climate, any or all of these very much favour it, as I have seen in cases which have come under my care; and it is not difficult to understand how they do so, if, as many physiologists think, the

liver has much to do in preparing the saccharine matter which is contained in our food (or is derived from the starch so easily convertible into sugar), for the two purposes it has to serve in the economy. These two purposes are to supply respiratory fuel and to furnish fat; and it seems that to adapt ordinary sugar to either purpose, the action of the liver is necessary, by which an intermediate substance (termed glucose, or liver-sugar) is formed. If this view is well founded, we need not be surprised that, when under the exhausting influences above named, the liver fails in its office, there should be a rapid diminution of fat (emaciation), while the kidneys remove from the circulation a large amount of unassimilated sugar. Now these (the emaciation and the sugar in the urine) are the special characteristics of *diabetes*.

The inference from these remarks is obvious. We have to avoid all the causes of exhaustion above named on the one hand — to promote healthy digestion, by careful observance of all the rules already laid down—and to adopt a diet entirely, or almost entirely, nitrogenous, to the exclusion of such articles as contain either sugar or *starch*, so easily convertible into it. The plan of diet here advised, is that commonly acted on; yet there have not been wanting some who have been bold enough to try an exactly opposite plan. The ill success of this experiment has, I believe, now brought it to a conclusion. The plan above advised might more often have full success, if it were *earlier* adopted, and if the other part of the treatment were carefully attended to at the same time. As to medicines—with steel and tonics—none is probably so reliable as cod-liver oil.

The object we have in view in introducing this and

similar topics, is not to induce our readers to undertake the management of their own case in this or any other instance of serious disorder; but rather to give them the means of knowing in time their need of the physician, and of understanding the rational principles on which they will have to concur with him, either for the prevention or cure of disease. In the case now before us, it will be obvious how much depends on this concurrence.

Before we quit the subject of the urinary excretion, we may offer a word of caution as to the necessity of prompt attention to the instinctive calls for its evacuation. It may not be generally known, that if this call be put off, it may recur once or twice, but more and more faintly, until, being unattended to, over-distension with ultimate inability to relieve the bladder, is the serious result. Moreover, when this has once occurred, although present relief may be obtained by surgical aid, it is often long ere the bladder recovers its tone. So much discomfort, and so many even fatal results, have arisen from neglecting this caution, that I make no apology for drawing the attention of my readers to the needful warning.

Another cause of impurity of blood from retained excretions, can only be glanced at here,—it is that *peculiar* to women; for there is no doubt that the *periodical* function should be regarded as in some degree excretory, and that the retention in the blood of what is thus to be thrown off, deteriorates its quality, as is evident in the sallow complexion attending this state. This altered condition of blood is probably the cause of that strong repugnance to animal food, or general loss of appetite, which so often accompanies such an *irregular* state, and in which it is so important not only to adopt measures to

restore appetite, but to regulate the choice of vegetable diet so as to obtain the best substitutes for animal food. Of this we have fully spoken in a former chapter.

The complicated actions of the living human body are naturally divisible into two classes; the first, those of organic or vegetative life; the second, those belonging to animal life.

To the first class belong all those functions and actions which we have in common with plants; and they have been thence called *vegetative.*

Plants absorb nourishment from without; they elaborate this—they re-combine its elements—they form fresh products in great variety—and thus the vigour and activity of each part or organ are provided, and the growth of the whole promoted.

Plants have their motions, both internal and external; their juices circulate in vessels provided for the purpose. We see that these motions respond to certain stimuli: the flower expands under certain influences, and as certainly contracts under others; the touch of a needle causes in many, instant and sharp contraction, as if indeed there really was such a thing as a "*sensitive*" plant. But plants are not sensitive. The license of poetic imagination may attribute such a quality to them, but no philosopher ascribes to them *feeling, consciousness,* or will. And plants have no nerves. Animals, even the lowest, have nerves more or less developed. Yet there is the closest analogy, to say the least, between the first class of functions in the animal, and the corresponding functions in the vegetable kingdom. For instance, neither feeling, consciousness, nor will, attends the digestion of our food; its absorption—the secretion of bile—

the formation of gastric juice, and the various chemical changes constantly going on in the blood and in every part of our frame—this all goes on independent of our will, and we are quite unconscious of its progress.

It is quite otherwise when we come to the functions of animal life; not merely those which distinguish man in his intellectual and moral being, but even in those lower functions which we have in common with inferior animals. To go to one of the lowest, even an oyster has a will, by which he opens and shuts his shell when he likes. And a horse or an elephant has so much of self-direction or will, that when he exerts it in opposition to our own, it takes, sometimes, the skill of a Rarey to equalize the balance between superior strength and superior intelligence.

Keeping this distinction in view between vegetative (or organic) and animal life, let us consider briefly the constitution of the nervous system, and we shall see that, as the governing and directing power of the whole animal economy, it is, in fact, the most important in its practical office, as the great conservator of health.

Unless the laws of health are understood and faithfully acted on in relation to this system, all the care and cautions which have been already inculcated, will be entirely unfruitful.

In order to perceive fully the force of this assertion, we must call the reader's attention to a most needful distinction, which has only been cursorily alluded to at a former page (see page 70). It has been observed there, that although various important secretions, as the gastric juice, the bile, &c., are not immediately *dependent* on the influence of the nerves, yet they are powerfully

influenced by them; and this distinction between the *cause* of a movement, and an influence or modifying power exerted upon it, has been illustrated by such instances as these:—the motions of a horse are not in any way assisted or caused by the will of his rider, *i. e.*, the horse would move just as strongly without his rider; yet the rider's voice, hand, and heel control and influence his movements, as we know. So the ship, moved by sail or steam, moves just as freely and strongly without the rudder; yet the rudder, in the hand of the steersman, influences and modifies all its movements.

The formation of milk in the human body seems a purely vegetative act, not unlike the production of similar fluids in the vegetable world; but we know by remarkable instances, how much this secretion is influenced by emotions of the mind. "A mother suckling her child was compelled to interfere, to save the life of her husband, between him and a soldier who had attacked him with a drawn sword. She courageously grappled with the soldier, took away his sword, and broke it. Immediately after this she took up her healthy child, and gave it the breast; but by the violent emotion she had gone through, the milk was rendered poisonous. In a few minutes the infant left off sucking, and sank dead on its mother's bosom."—(Dr. Von Ammon, quoted by Dr. A. Combe.)

Infants have been seized with convulsions after sucking the wet nurse who had been severely reprimanded. A caution to mothers.

From these instances of the importance of nervous influence, we pass to the consideration of the nervous system itself.

CHAPTER XIII.

THE NERVOUS SYSTEM.

The brain, spinal cord, ganglia, and nerves distinguished, yet connected —Their functions—Material of brain and other nervous centres, and of nerves—Chemical composition—Forms—The superior portions of the brain the organs of the mind, intellect, &c.—Futility of attempts to localize the soul, or to find *one* centre of life in the body; since there are many—Importance of due nutrition to the perfection of thought—The brain may be injured or disorganized by excess of thought—The brain and other portions of the nervous system injured by all excessive emotions and passions—Consideration of these in relation to health—Influence of body on the mind—Health favourable to *moral* improvement—Popular errors on this point—Function of self-control—Practical inferences from the foregoing views.

THE nervous system is capable of a threefold division,—the Brain, the Spinal System, and that of the Ganglions; not that these are separated from each other, for they are, on the contrary, continuously united, and form a whole, as much as, in a tree, do the trunk, branches, and roots; and yet, as these three parts of a tree are distinguishable, not only by name, but have each peculiar functions, so is it with the brain, the spinal and ganglionic systems.

The brain, occupying the highest region, is the seat of thought—of emotion—of will. To the spinal marrow and its nerves chiefly belong the functions of *in*voluntary muscular motion, and to the ganglionic system the influence regulating the functions of nutrition, secretion, &c.

To the general reader we must, to avoid complicating

the subject, speak of the brain as one organ; but it is rather an assemblage of organs, and to these various portions of the brain, or various organs (forming the whole), have been assigned different offices;—to one part sensation, to another perception, to another will; and even each faculty of mind has its distinct organ assigned.

It would be beyond our purpose to enter into the arguments for and against the so-called phrenological division of the brain; but the following are undeniable facts.

1. There is a general connection between the full and perfect development of the brain and the extent of mental endowments.

2. That, as the greater development of the anterior and superior portions of brain marks the difference between man and the inferior animals, so, when we compare among mankind one head with another, the comparative expansion of these regions corresponds generally with a comparative superiority of intellectual, and even moral dualities.

3. There is often a specific superiority in certain peculiar faculties and talents,—memory, for instance, the musical faculty, &c.; while there may be a relative mediocrity, or even positive inferiority, in other respects.

4. That, in certain states of disease, or partial injury of the brain, the alteration of mental capacity is found to affect only some particular specific faculty or faculties, leaving others comparatively untouched, a blow on the head, for instance, being followed by an almost complete loss of the memory of *words*, while the judgment and perception remain as good as ever.

And lastly, defects in the supply of blood to the

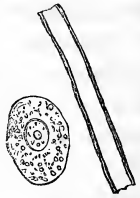
brain (as during a very weak circulation), or such defects in the quality of blood as diminish or pervert the nutrition of the brain, are attended with a corresponding weakness of the mental faculties generally.

Now, this last observation is of the greatest practical importance, as it shows the entire dependence of the brain, as the organ of thought, on the due performance of the functions of organic life, digestion, assimilation, &c. It is admitted by all physiologists, that no vital function is exerted by any organ without some change of its substance, some chemical action, ending in a waste and disintegration of its particles, which are to be replaced by fresh material.

The brain is not exempt from this law: every thought implies waste and change in its *most minute particles.* We need not enter into details as to the *structure* of the brain and nervous matter generally; suffice it to say, that the nervous substance is, as to form, of two kinds—1. vesicular, *i.e.* composed of little vesicles or corpuscles, small bodies, which are, in fact, *cells*, having in them a nucleus, as is seen in the accompanying figure. The second form is that of nerve-fibres, very minute cords, laid side by side, nearly parallel to each other. This nerve-fibre is distinctly tubular, of the size, in the brain, of $\frac{1}{7000}$th of an inch, to even half this size; so that 14,000 would lie side by side in the space of an inch. In other parts, as in the course of the nerves, they are larger by three or four times. Each of these tubes is composed of a delicate sheath or membrane, in which the nerve matter is contained.

The vesicular or *cell* matter is found in the nervous centres *only*, that is, in the brain, in the spinal cord, and in the ganglia. Hence this vesicular or cell matter

is supposed to be the seat of all sensory power; while the tubes or fibres, of which the nerves themselves are composed, are merely conductors of this power *from* the nervous centres, and of impressions made on their extremities *to* these centres. We need say no more on the form and functions of the nervous system, merely observing, in conclusion, that the nerves of the special *senses*—hearing, seeing, smelling, &c.—are connected directly with the brain; those of the involuntary motions, as breathing, for instance (which goes on in sleep when the will does not act), are connected with the *spinal marrow as well as the brain* (this conjunction of the two is technically called the cerebro-spinal system); and hence, although respiration goes on without any conscious exercise of the will, yet is it to a certain degree under control of the will, whose seat is in the brain; for we can take a deep breath when we will, or we can at pleasure breathe fast or slow (so long as we keep within the limits consistent with life itself). This is an illustration of the mixed function of the united brain and spinal marrow taken together.



Nerve-cells and nerve-fibres or tubes (much magnified).

Lastly, we may observe that the nerves belonging to the organs of the vegetative life, whose constant action is needful to sustain nutrition, circulation, secretion, &c., are directly connected with the ganglia, and they are, at least, not dependent on the conscious exercise of our will.

In this brief outline of the nervous system, we have assigned to each of its three divisions its *predominant* function: to the brain proper, *intellect*,—to the spinal

cord, *involuntary motion*,—to the ganglia, the control of the *nutritive* processes; but if we would form a more exact conception of these functions, we shall have to take into account several ascertained facts, which I can scarcely do more than mention.

To state the means by which these facts are arrived at, the inferences which may be drawn from them, and their mutual bearings, would require a volume.

1st. It is only the *superior* portion of the brain which is the organ of intellect; the other portions are *sensory*, while that which *connects* the brain and spinal marrow (called medulla oblongata), is the seat of *respiratory* function, and, as such, essential to the maintenance of life; so that the division or destruction of this part is more rapidly and certainly fatal than that of any other portion whatever.

2nd. Although the higher faculties of mind are exercised only through the brain, yet *a degree of intelligence* is manifested by those lower animals which have no brain, or by an animal from which the brain has been removed. A brainless tortoise will not only survive the removal of the organ for months, but adapt its motions to certain ends, showing some degree of intelligence.

3rd. *Sensibility*—taking this term in its widest sense—is not confined to the brain and spinal marrow, but is found in those ganglia also which are not *directly* connected with either: these are also true nervous *centres*, of which sensibility seems to be the common property.

4th. The Soul* is that element of our constitution which distinguishes the living body from the dead. It is unknown (and perhaps unknowable), but by its

* Anima, $\psi\upsilon\chi\eta$ of the ancients.

manifestations (vital phenomena). The aggregate of these manifestations, or powers of an organism, we call its *life*.

The soul has been by some represented as the living inhabitant of a dead house—the body. This is quite inexact. The *Spirit*,* indeed, inhabits the body of man, but the *living* body only. It is the soul—the *life*—which fits the body for such inhabitation; and this is quite distinct from the spirit, although often confounded in the loose language of modern writers. Man consists of *Body*, *Soul* (the life of that body), and *Spirit*.

We may see, then, the futility of the attempts to localize the soul in any particular part of the body. Descartes fixed it in the *pineal*† gland, a conceit quite unfounded. If we conceive rightly of the soul of man, we shall perceive that it must be where life is, that is, throughout the whole living organism.

We need not, therefore, be surprised if *feeling* (sensation in some of its diverse modifications) be attributed to the ganglia of the organic or vegetative system; while, on the other hand, the faculty of *perceiving* such sensations, of placing them, as it were, in an *objective* point of view, belongs exclusively to the brain.

We may be doing two things at the same time, yet take knowledge only of one; and it has been attempted to explain this fact by a supposed "duality of the mind"‡ (as Dr. Wigan has done); but this will scarcely explain cases where we may be doing three, or even four, things at a time, and yet have knowledge only of one. One may be at the same time walking about,

* Πνευμα of the ancients. † A minute portion of *the brain*.

‡ Corresponding to the two symmetrical hemispheres of the brain.

playing some familiar tune on a violin, and talking to a friend, without fixing the attention or making any conscious effort, except in *one* (the last) direction. It will be seen that in this case four distinct processes are involved, and each, so far from being cognate, is rather antagonistic to the other. To find the right intervals with the fingers of the left hand, to manage the bowing with the other, to use the feet, and to direct the thoughts and the tongue with exactness, suppose at least four different actions; yet we may be at the moment *thinking consciously of one only.*

Although the nerve-fibres have been spoken of as conductors, it must not be supposed that they have no inherent power; for they respond to stimuli applied, and that even when their communication with their centres has been suspended by ligature. They can in this case no longer convey impressions *to* those centres, but they produce contractile action in the muscles to which they proceed in the other direction.

Our space does not permit us to pursue in further detail this very interesting subject of the functions of the nervous system. Those who may wish to study it, may be referred to two leading authors, Dr. Carpenter and Mr. G. H. Lewes, whose views are not entirely coincident, but from both of whom we acknowledge to have gathered much which we have laid before the reader.

The chemical constitution of nervous matter is of more importance, and has a direct relation to our subject. It consists, besides water, of albumen, fat, and phosphoric acid,—chiefly the two latter substances are supposed to be in combination; and it cannot be without a purpose that this peculiar constitution of the nervous matter exists, and that the proportion of the phosphorized fat

compound is found to be the *greatest* in mature or adult age, somewhat less in youth, and *much less* in *extreme age and in idiots.* Dr. Carpenter ("Physiology," p. 193) observes: "There are many reasons for regarding these —the phosphorized fats—as the active agents in the operation of the nervous system. It will be remarked, that the amount of phosphorus is the greatest at the period of greatest mental vigour, and that in infancy, old age, and idiocy, the proportion is not above half that which is present during the adolescent and adult periods."

We are glad to be able to quote so high an authority as Dr. Carpenter in favour of this view, which seems to be only a fair deduction from admitted facts; for the illustrious Liebig, from whom it is so difficult to dissent without the sanction of something like equal authority, has made himself exceedingly merry with one of his fellow-countrymen (*Moleschott*), who has ventured on the apothegm, "*no thought without phosphorus;*" and the reason Liebig assigns for this ridicule is the following:— "No one has ever yet detected phosphorus in any part of the body, of the brain, or of the food, in any other form than that of 'phosphoric acid.' The notion that such other compounds of phosphorus exist in the body, and that their presence is connected with the production of thoughts in the human brain, proceeds generally from amateurs in science, and rests on superficial observation, without the slightest scientific foundation."—(Liebig's "Familiar Letters on Chemistry," 4th edit. p. 467.)

The case seems to stand thus—

1st. There is no action of the brain, that is, "no thought," without a proportionate molecular change, implying a waste or change of substance.

2nd. Phosphoric acid and fat are characteristic components of that substance.

3rd. No phosphoric acid exists without phosphorus.

Now each of these three propositions seems to be plainly taught by Liebig himself (see his works, *passim*), and it is difficult then to see how the rather bare statement, "no thought without phosphorus," deserves the ridicule it has met with.

If we adopt Dr. Carpenter's view, it does not necessarily follow that we must regard every "flash of wit which sets the table in a roar" as literally a *phosphorescent* flash.

But, recognizing the relation of the phosphatic component of the brain to its peculiar functions, we shall attach some importance to the due supply of *the phosphates in our food*, and shall not err in considering a defect of our diet in this respect to be one cause of diminished nervous power. Liebig himself does not hesitate to ascribe to such a cause a weakening of the bony structure, because phosphate of lime (bone earth) is one of the essential constituents of bone. Is it, then, quite unphilosophical to attribute defective condition of the brain to the same cause, merely because the phosphoric acid is united with fat instead of with lime?

In the practical application of this view to the question of waste and supply, we are, however, quite independent of theory; and we must in this case, as in many others, see that we distinguish rightly between matters of opinion and matters of fact.

Whatever may be the explanation, it is quite certain as a fact, that mental exertion—the excitement of the various emotions and passions of our nature—does exhaust nervous power; and, if carried too far, tends to

the disorganization of the brain, or spinal marrow, or both.

But when is such exertion or excitement carried too far? This question must be answered on grounds which are entirely relative; that is, excess of *waste* depends on the relative strength and power of endurance of each individual, and on the *supply* which in a given time is afforded by the restorative and nutrient functions, so that the disintegration of particles may be replaced by new and sound materials. It is the same with the nervous as with the muscular power, the question of excess in muscular exertion being governed by the amount of restorative power obtainable in a given time by rest, and the nutritive and assimilative functions. As this varies in different individuals, so does the capability of exertion; but in both cases the result is greatly influenced by *choice* of diet, regimen, &c.

Where the waste exceeds the supply, and this inequality continues to prevail for any lengthened period, the organs of nervous power must suffer damage.

It is necessary, however, for practical purposes, to consider in fuller detail the various ways in which nervous power may be expended.

The first may be termed *excess of thought*. It is not only the student, properly so called—reading perhaps for honours at a university—and the literary classes generally who are liable to this; but vast numbers of persons engaged in mercantile and trade pursuits are the victims of excess of thought. What is the remedy for this? In vain shall we make cool, philosophical comparisons between the relative value of honours and wealth on the one side, and the inestimable blessing of health on the other. These common-places avail nothing. Men

will pursue these objects, and some—with generous self-forgetfulness—will devote themselves, without thought of consequences, to excessive mental labours for the welfare of others. There is even a prevalent notion that *greatness* in intellectual pursuits can only be attained at the expense of health; that it is the natural price we are called on to pay; and that, if we would give the *mind* its FULLEST scope, we must accept, as the natural consequence, weakness, if not disease, of the body. An estimable writer has given eloquent expression to this prevalent view. (See "Sermons," No. XV., 1st Series. By Rev. F. Robertson.) He says: "You cannot have the store of information possessed by the student and enjoy robust health. Pay his price, and you have his reward. His price is an emaciated frame, a debilitated constitution, a transparent hand, and the rose taken out of the sunken cheek. To have these *opposite things*—the student's prize and rude health—would be to mock God—to reap what has not been sown."

It must be admitted that the man of letters cannot expect generally to possess the muscular strength and development of a railway labourer or a thresher, and that, within the limits of health, there may be degrees of strength and muscular activity to the highest of which the devoted student may not attain.

Nevertheless, we must doubt the correctness of this exposition, and maintain that—by avoiding all *excess* of thought, all over-tasking of the brain—*more may be got out* of the mind, in its final results, than by the violation of the laws of health, which is now thought the inseparable penalty of intellectual eminence.

Homely as the comparison is, we really believe the case of intellectual work is amenable to exactly the same

law as that which regulates the toil of the working horse.

The experienced horse-master knows well, that, by assigning to the horse only a *moderate* amount of daily work, with his occasional rest-days, he will in the long run get more out of his horse than by any other plan.

At the same time he takes care that he is well fed and well groomed. It is in one case the muscle and *nerve* of the horse—for a horse, be it remembered, *has nerves*—that must be used no faster than its waste can be restored. In the other, it is the nerve of the man, which must be treated on exactly the same principle ; for both the brain and nerve of the man, and the muscle and nerve of the horse, are alike dependent on the supplies they receive through the organic system ; and if more can be made out of the brain, considered as the working organ of mind, by expending its power *and substance* (for one implies the other), without regard to the rate of its supply, why should not the same result be obtainable in the case of the horse ? Why should it not be found good economy to over-work the horse, and to *dis*regard the law of health in his case too ?

When we speak of mental results, we would be understood as taking quality as well as quantity into account ; and we submit, with some degree of confidence, that the noblest flights of human thought, as well as the most enduring efforts, are to be looked for in conjunction with soundness of health. So far as this can be measured by longevity, and *activity* prolonged into advanced life, we have remarkable proofs, both among the living and the dead. We need but mention, among the first, Lord Brougham, Lord Lyndhurst, and many others ; among the illustrious dead, Newton, Galileo, Halley, Herschel,

Humboldt, and many other deep and hard thinkers. The *musical* inventors seem to offer a contrast to this list. Purcell, Pergolesi, Mozart, Weber, Mendelssohn—all died young (between thirty and forty); Haydn and Beethoven attained a good age, though the later years of the last were passed in sad discomfort and infirmity.

Excess of thought, however, is not the only means by which the brain and nervous system are weakened, injured, or even destroyed. The passions, both the nobler and the less noble, have their full share in this process. Ambition, avarice, envy, anger, jealousy—all these, by inducing excessive emotion, not only exhaust the brain, but also the nervous power belonging to the organic life, and connected with the ganglions. Mere intellectual exertion, if carried too far, or ill-timed (as just after a meal), affects indirectly the functions subservient to nutrition; since the brain and the ganglia are *connected*, although their functions differ. But the passions we have just named, and in which feeling is deeply stirred, affect the organic functions more directly; for, as we have seen, a fit of anger or jealousy is capable of *suddenly* changing the character of the secretions, as the bile, the milk, &c., and of suspending the flow of gastric juice, so essential even to the commencement of digestion. But, apart from these sudden results, there is the more constant *waste* arising from the *habitual* prevalence of these emotions of the mind, by which the nervous power is consumed at an undue rate, while its production is at the same time diminished; because this very disturbance of the nervous influence hinders or perverts the nutritive process. This is what is vulgarly, but significantly, termed "burning the candle at both ends."

The relation between the sexes gives rise, also, to

influences which, rightly ordered, conduce eminently to health of mind and body; but, in their *dis*order, are productive of more injury to both than any other single influence which can be named. It will be thought a most presumptuous thing, perhaps (and some of my poetical readers, if I am honoured with such, will scarcely forgive me), if I meet the assertion of our great poet—

"The course of *true* love *never* did run smooth,"

with another—The course of *wise* love almost always does. And, with submission to poets, novelists, and melancholic young ladies and gentlemen, may we not believe and hope that *wise* love may be no less *true* than the wild passion which alone is supposed to deserve the name?

We may observe, that it is just that love which is founded on esteem and governed by reason, which, from the very nature of the case, is the least liable to be unrequited; for it is not until a reasonable conviction is attained that there is congruity and suitableness between the parties, that the wise allow a strong attachment to take so firm a hold that it cannot be loosened. To them, therefore, the trial of mind which arises from strong love on one side, unrequited on the other, can come but rarely. It is quite an exceptional case, and may be regarded as an unusual mistake; but when such a mistake *has* arisen, it may be corrected with somewhat less difficulty than has often been represented in sentimental stories. With regard to that case of monomania usually described as "falling in love," the matter is very different; it will be very frequently unreturned and unrequited, and if returned, the consequence is usually not much better; for I appeal to the experience and observation of my readers,

and ask if they do not bear out my assertion, that a very large number of the most *un*happy marriages are brought about in this way. I do not say that this is the sole cause of such sad results as are daily chronicled in our law courts; but among the marriages founded on sudden attachments, the most have no good result.

And what else could be expected? For is it not equally true in all other affairs of life, that when we have been guided by passion instead of reason, we have reaped bitter fruit? Then why should love affairs be an exception? If we form friendships (so called) without esteem founded on well-ascertained grounds, are such friendships attended with much benefit? Certain it is, that badly-governed passion is one fertile source of disorder and disease in both sexes. It powerfully disturbs and weakens the nervous system by the violent emotion it occasions, and through it disturbs the functions of the whole body. The records of medicine, and of our asylums for the insane particularly, are full of its evil consequences; since it is recognized as the cause of unsoundness of mind in a large majority of cases. Reason ceases to be our guide in such a state, and we are drifted helplessly along on the stormy sea of life, till we make utter shipwreck of all that renders life valuable.

That we may avoid these evil results, it is necessary first that we form a right conception of the true nature o this affection, to which the name of love properly belongs.

The complex affection in which the higher and the lower elements of our nature are duly blended, is then alone raised to its true dignity, and we realize its brightest ideal,—when, in paying our tribute to beauty, we regard it rather as the exponent of the nobler endowments of humanity than as a substitute for them.

We cannot presume to enter into the moral and religious considerations so closely connected with this subject; that is the office of those who are worthy to be the expositors of Divine revelation and its sublime morality. But the physician cannot, if he would, apply the laws of health, without taking into account our higher mental nature; nor can the right government of the various passions and affections of man be treated, without considering the influence of the body on the mind both in health and disease. Moreover, from the physiology of the nervous system may be deduced one rule of no small value in the endeavour to apply that self-discipline which may enable us to resist and control the blind impulses of passion.

We are by nature endowed with the faculty of directing our thoughts by the will. We can withdraw our attention from one object, and fix it on another; and we are conscious of the possession of this faculty from our constant experience. It may, however, not be so generally observed to what degree this power varies in different persons—in the same person in different states—and how much it may be improved by cultivation and exercise, like most other faculties, mental or bodily.

Nor would it, at first view, seem credible that this power of the concentration of thought may be exercised so as to suspend for the time all perception, even of the strongest impressions made on our senses from without. In battle, the chief who is leading on his soldiers to assault some stronghold, heeds not the fearful sights and sounds about him—feels not at the moment the wounds inflicted on himself; his will is strongly bent on the purpose before him—his thoughts are concentrated on the means of fulfilling it. So it is with the martyr at

the stake, who has his mind filled with the aspirations of faith. Even the North-American Indian, while enduring all the tortures the ingenuity of his enemy can invent, is not the *passive* sufferer he seems. By the *active* exertion of this strong faculty of the will, he becomes the heroic assailant; he taunts his adversaries with their little skill in the art of tormenting, and while he is exulting in the thought of what he himself has *done*, he powerfully puts down all perception of what he has now to suffer. Now it is just this faculty of a strong will *directing the attention not to the lower impulses* to be overcome, but to the higher antagonistic thoughts, that impart the secret of domination over them. The one must displace the other, and then the strongest bodily instincts and impulses are brought under the complete control of the will.

But, it will be asked, Have all this power or faculty? All have it in greater or less degree originally; but unless developed and exercised, it will dwindle. And its vigorous exercise, also, may depend on the health of the nervous system itself. Where this has been much weakened by excess, either of thought or emotion on the one hand, or by defective nutrition on the other, can it be expected that the same resolute will should be manifested as in the instances cited above? When the brain, the organ of thought, is itself weak, one of the most marked symptoms of that weakness is the inability to direct the attention by the will—to fix or sustain its application to any one subject.

The difficulty in such a case is similar to that which exists in the case of a weak limb, which it is desired to strengthen by exercise. The little strength remaining, must here be used to obtain more, and by persevering efforts the strength will be gradually regained. So it is

with the brain itself. The precept here must be, "Use all the resolution, all the will you can muster, to give your thoughts and attention a right direction, and daily will you find the power greater and greater of obtaining the mastery and control over all merely *sensational impulses*."

It need scarcely be observed, however, how much of our success depends on a faithful obedience to the laws of health, which apply to the nutrition of the brain, and to those which regulate the waste of nerve-power, and maintain its balance with the *supply*. If we do not avoid the *causes* of disease, we cannot hope to remedy that which already exists.

We may distinguish between this act of *self-discipline* and the well-known expedient of trying to divert the attention from any engrossing passion, by varied amusements and occupations. Such expedients are very important, and comprise the best that our friends can do for us, or that we can do for ourselves, by choosing the *circumstances* which shall surround us as far as we *can* choose. But this is quite distinct from what we are called on to do for ourselves, irrespective of circumstances. Our choice of circumstances and *external* influences is often very limited. But the opportunity for self-discipline we always have.

The following case of physical weakness may illustrate the nature of the disability which I propose to remove by the strong determination of the will. Not unfrequently the physician is called to see cases of supposed paralysis, in which the patient, usually a delicate young woman, who has suffered from some of the causes above described, producing defective nutrition, and, as a consequence, what is called a nervous hysterical condition. This has gone

on until the power of using the lower limbs seems entirely lost. The patient takes to her bed or couch, and is scarcely expected to walk again.

Now all this may occur, and has indeed often occurred, without any evidence of organic change, either in the spine or elsewhere. Of such cases it has been observed, "The patient could walk if she could try, *but she cannot try.*" She may even have the *wish* to try, but seems not to have the power; that is, she has either not the power to make the will effectual in conveying its behests to the limbs, or she has not the power of exerting that strong volition or *will.*

It is on one of these two grounds that we can alone explain it; and which is the right view? I think it is the last; and accordingly, when from improved nutrition the brain can be rendered capable of strong will, the cure is effected. Sometimes this result appears to be brought about by the intervention of some friend in whom great confidence is reposed, and who exercises a powerful influence over the patient; and this may be without the use of any ordinary means of cure. A powerful incitement brings out the latent power of will, which was already there, waiting, as it were, for the inciting force. It is clear that in such a case the friend adds nothing to the physical power already existing, he merely *educes* it, or calls it into exercise.

Now what the friend does in this case for us, I would say, *we may do for ourselves*, in the matter of directing our thoughts in a course which is antagonistic to our mere sensational impressions, and which is capable of entirely controlling them. This then is, I humbly believe, the true ground of self-discipline: "What is to be done, you can do if you can *try.* Will—honestly, resolutely,

and you will be *able to try*." We see, then, that we possess a faculty of the brain, by which we are fitted in our very organization to keep all our lower instincts in complete subordination to reason and conscience.

The most legitimate gratifications, it is plain, must be regulated as to their *degree* likewise; *excess* in things lawful becoming *inexpedient* and hurtful. There is no need to lay down a rule for the guidance of reason and conscience in the case before us. It is sufficient to say, that what we learn from our experience has the effect of lowering the vigour and activity of any of our functions, mental or bodily, *is for us excess*. But if excess, even in what is lawful, is thus inimical to health both of mind and body, how much more so is every kind of unlawful indulgence!*

In concluding this subject, one general observation may be made, which applies to all moral discipline, regarded in its relation to the state of the bodily health. That the moral control of all the passions is in general more difficult in proportion to the unhealthy state of the body; that, therefore, in promoting the vigour of the body, we lessen the force of temptation, and increase the power of our self-control. This is not to be doubted, if

* It is in allusion to this that an eminent divine thus writes:—"It may be said to all parents, Ye may safely, ye cannot too early or too earnestly, impress upon your children that they are the temples of the Holy Ghost; and therefore reverence thou Him that dwelleth within" . . . "What you would not do if I were by, *that do not when alone;* for you are in the presence of God, and He is as much within you as your own soul."

A well-known medical authority, Dr. Copeland ("Medical Dictionary"), says: "This subject has been improperly neglected both by instructed writers and scientific physicians." We may refer for any further information on this point to that eminent writer.

we consider for a moment that all deviations from the laws of health tend to *pervert* our natural instincts, and to add to them morbid incitements of an evil tendency; while the perfect exercise of self-control depends much on the perfect and healthy condition of the organ of the mind—the brain. The Christian problem, then, how to "keep under the body, and to bring it into subjection," as St. Paul expresses it, is to be solved, not by weakening the body, but by promoting the healthy balance of all its functions, and especially of those *through* which our mental faculties are exercised.

The *mens sana* (the healthy mind) can only be fully exerted *in corpore sano* (in the healthy body), and it would scarcely be possible to estimate how much moral evil is indirectly induced by unhealthiness of body; while this unhealthiness is but too often the plain consequence of some moral declension. Thus a vicious circle is established, and the moral and physical take place alternately as cause and effect. But if this is the case on the bad side, we may be sure it will prove to be equally true on the good side; and moral and physical health will each one in turn aid the development of the other.

This view has been dwelt on more fully, because there may be in some quarters a misapprehension of the subject. Some may have even made the mistake of thinking that, to weaken evil passions, you must weaken the body itself, in which they are supposed to be inherent; but the truth is, in this way you usually rather strengthen the force of evil, and only weaken the good forces—that is, the power of self-control.

What are we to say, then, of fasting, or other ascetic acts of discipline? We say that, in so far as these are rightly and wisely used, they do *not* injure, but promote

health of body as well as of mind; and that, when they have an opposite influence, they are *unwisely* used, and tend to defeat their avowed moral purpose.

The Author of Nature would be the author of confusion instead of order, *if* it were true that the perfection of our moral nature could be accomplished only by the sacrifice of the physical powers; but it is not so. The full harmonious development of the whole man—considered even in his highest aspects—consists with the healthy exercise of all our functions and endowments, from the highest to the lowest. At the same time, it is one of the characteristics of our nature that it can adapt itself to every variety of state—to a great diversity of outward circumstances and influences—yet only within certain limits fixed by the Author of our being.

The law of nature is no other than the law of God. For His own wise purposes, He has given to the instinct of which we speak the force of a rule so general, as to admit only of exceptions arising from far higher considerations than mere worldly maxims. If we, on these latter grounds, attempt to set aside the natural law, we shall never get rid of *the* social evil—nor of many other social evils less know nor observed—without exchanging them for worse.

The self-discipline we have described will have always opportunity and scope enough, but it will not uphold us in endeavouring to evade the law of nature, which our will can never set aside.

Whatever may be urged as to the inconvenience of early marriage, will appear insignificant in the eyes of those who have witnessed the evils arising from enforced celibacy on the one hand, or from vicious substitutes for marriage on the other; and the mothers who have

daughters to marry, can only avoid the evils of enforced celibacy for *them*, when the mothers who have sons shall have come to think that they ought not to dissuade their sons from early marriage, even should such a step involve the necessity of industry and frugality.

CHAPTER XIV.

LIGHT.

Its great influence on health—Its relation to vital action—Chemical effects—Abundance of sunlight an indispensable condition for the cure of certain disorders—Light needful to the health even of the *blind*, proving its influence on vitality.

We have yet to consider one influence which is absolutely necessary, both to the perfection of the blood and its vital transformations, and to the full activity of the nervous system itself: it is the influence of *light*. It has been long well known that the vital development of plants—resulting in the varieties of colour and in various organic products, can be effected only by the agency of light.

Modern researches into the nature of light, and of the sun's direct rays, have given us some further ideas of the variety of effects attributable to them—electrical and chemical, as well as those connected more immediately with colour. The operations of the photographer, also, illustrate the extreme delicacy and subtlety of these influences; so that we cannot be surprised at the fact that the blood and the nervous system—the depositories of chemical, electrical, and vital forces—should be powerfully actuated by the sun's rays, which bear direct relation to *all* these forces.

With regard to colour, it is known that, as in plants, so in the human skin and hair, the colouring or pigmentary cells are developed exactly in proportion to the sun's influence. This, at least, is the rule in health.

With regard to chemical and vital influences on the blood and the nervous system, we know little directly; but we know what are the results of the *absence* of light.

This never fails to depress all the vital functions, and to deprive the blood itself of those properties on which its power of supporting life depends. Such persons as are habitually deprived of the salutary influence of light, become bloodless, pale, weak, short-breathed, and subject to morbid growths of various kinds; and this is daily an unsuspected cause of an immense amount of fatal disease—scrofula—tubercular consumption. This is particularly the case in the confined dwellings to be found in the narrow streets of large cities. It should be remedied, when possible, by change of habitation; by obtaining the *direct* access of the sun's rays; or, failing this, at least as much reflected light as possible should be obtained by the constant use of whitewash in quarters adjoining such confined apartments. The lime has other salutary effects beside.

It has happened to every medical man to see cases of disordered health—perfectly intractable by *any* means, in the absence of due amount of light and air—immediately and rapidly remedied by simple removal to a spot where these could be abundantly enjoyed. It is not often we have to guard against an excess of light; yet this is sometimes the case. The very weak, the infirm and aged, cannot bear a very large amount of the exciting effect of light; and still less of the *direct* action of the sun's rays.

As a proof of the important influence of light, one or two instances may be given. Certain gases may be mixed (mechanically), and will remain for a long period without chemical combination, so long as they are kept in the *dark;* but if exposed to sunlight, they will combine, and form a new body.

It has been found, in the construction of asylums for *the blind*, that a due supply of sunlight is necessary to *their health*, although they cannot enjoy *all* the blessings of light.

CHAPTER XV.

SLEEP.

Use of the special senses suspended during sleep—Thought, and conscious perception in abeyance, but sensation and will not entirely so; in some cases, however, sufficiently to admit of much injury being inflicted without awakening us—Instances—Use of sleep as a restorative—Not dependent merely on the extent of nutrition going on—Quantity of sleep required—How regulated—Means of obtaining sound sleep—Rules.

In the reparative process of nature, or that by which the waste of material and power—the constant result of action—is made good, sleep holds the next place to food.

It may be observed, that in general the same rule holds good with regard to both sleep and food. The quantity required is in proportion to the amount of activity previously exercised; but the requirement of sleep is regulated rather by the activity of the nervous than of the muscular system. Thus it has been observed, that literary persons, in whom the brain is much exercised, require (other things being equal) more than those whose pursuits involve little thought.

This is a very obvious consequence of the nature of sleep itself, which consists chiefly in the suspension of activity of those portions of the nervous system which minister to thought, to the senses, and to perception or consciousness. This is our state in complete or profound sleep; and to what extent even common sensation is suspended in deep sleep, there is the testimony of many very curious facts. It frequently happens that a mustard plaster, used as a remedy, has been applied when a patient is inclined to sleep. One would think that the sensation of burning pain which it always induces when we are awake, would quickly rouse the patient. This is by no means the case, and after some hours, perhaps, he awakes to find a very severe and painful blister produced, while he was quite unconscious of any pain during the process. But a still more extraordinary proof of suspended perception during sleep is well authenticated. A vagrant, some years ago, lay down at night on the border of a lime-kiln, with his feet hanging over the edge of the kiln. He fell asleep. The workman in charge of the kiln made the usual fire, and ere morning the heat was sufficient to burn the poor wanderer's feet almost to a cinder; yet of pain he must have been quite unconscious, as he continued to sleep soundly through the process.

Sleep, of course, adds nothing directly to nervous power; it merely suspends, or rather diminishes, its waste, while *a* restorative, if not the nutritive* process,

* The common idea is, that nutrition goes on even *more* efficiently during sleep than in the waking hours; but there is, undoubtedly, some force in the objection brought against this view, that *nutrition* is correlative with *waste*, which during sleep is supposed to be *less*. The waste, probably, *is* less during sleep; but it does not follow that there is no *other restorative* for lost energy, whether of muscles

going on all the time, builds up and renovates the exhausted nervous centres; so that when we awake after refreshing sleep, we have an accumulated stock of nervous power ready for use.

As to the quantity of sleep required, no rule can be laid down, since it must be proportioned to the waste, which varies in each individual case. Experience soon teaches the extent of our natural requirement.

It should be sufficient to maintain full activity of all the nervous functions, particularly those of the brain; and if, by a false economy of time, it is allowed to fall short of this, the brain will assuredly suffer damage. One rule, however, may be taken as well established; a moderate amount of *complete** sleep is of greater restorative value than a larger amount of *im*perfect sleep. By imperfect sleep, we mean that accompanied by dreams, &c.

There is no doubt that a considerable portion of the

or nervous centres, than that which would ensue from change of matter (or nutrition, properly so called). There may be, and probably is, some other means of renewing these powers; it *may* even be electric influence evolved through the circulation, without the ordinary change of matter in muscular or nervous substance. If we could be sure that it is *not* by ordinary nutrition it is renewed, and if we know not what the process is,—the fact that it *is* so renewed is plain. Even a metallic spring, or any elastic substance, regains its power by *rest*. The living organism may, during sleep, have the benefit of *this* resource, and perhaps of others still more efficient, although to us unknown.

* Strictly speaking, sleep is probably *never complete*—it admits of every degree; but neither sensation nor even the higher faculties are ever entirely suspended; and, without entering into the well-known question, whether dreamless sleep is even *possible* (although dreams are often unremembered), we may venture to doubt whether complete sleep would be compatible with life.

time devoted to sleep, is often of little use, because of the incompleteness of the sleep itself; and this arises almost always (in the absence of marked disease), from errors in diet and regimen. Some fault in the nutritive processes described in the earlier pages of this work, is the most frequent cause. A few rules may be laid down for obtaining sound sleep.

1. Take care what and how you eat and drink during the day, and *every* day.

2. Take only very light food within two hours of retiring to bed.

3. Dismiss all topics of business or study for the same time before rest.

4. Make not the couch your place of conversation, or for resolving problems which may have puzzled you during the day. The *next* day, when you are taking a walk* alone, is the best time and way of doing that.

5. Take your sleep as early in the night as you can.

6. At the moment you seek sleep, let your thoughts dwell on the morrow, rather than on the day just past; for this reason, that the anticipation of what we hope to be, to do, and to enjoy, is always brighter than the remembrance of what we have been and are. (The self-scrutiny of the day, which all the wise recommend, should have been gone through long before.)

* "*Solvitur ambulando*" may be taken in another than its usual sense, and in homely English—"You may settle it as you go."

CHAPTER XVI.

EXERCISE AND RECREATION.

Active and passive—Seasons and times for exercise—Choice of kinds—In and out-of-door—Adaptation to different vocations—To the robust and the delicate—Amusement for those who have found their work and are doing it—For those who have not—Problems of the day—Work and recreation for the infirm in body or mind.

THE importance of exercise in promoting the full benefits of respiration, the circulation, and of the action of the skin in a state of health, has been already adverted to. It remains to consider its practical application.

Exercise is usually distinguished as passive or active; the passive comprising swinging, sailing, riding in carriages, &c.; the active, walking, running, riding on horseback, rowing, fencing, and all athletic games.

The passive exercises are alone, as is evident, practicable by the very feeble; but for the preservation of health, or its restoration where only moderately impaired, active exercises in the open air are to be much preferred.

When our pursuits admit of a free choice of the times for exercise, the robust may begin theirs in the early morning, before breakfast; but this time is quite unsuited for those who are in any degree weak or delicate. Such persons should not rise very long before they have the opportunity of breakfast, and they should avoid all active exertion until between breakfast and dinner; and supposing this meal to be taken in the middle of the day, the early evening is another fit period for active exertion.

The two hours after dinner ought to be a time of rest, as far as possible.

Walking is the exercise most *generally* to be recommended, in preference to all others. Next to this, riding on horseback, rowing, fencing, cricket, &c., are best suited to those whose serious avocations involve much thought and sedentary habits; while (if we seek recreation rather than mere exercise) for those whose employments require much locomotion and less mental application, a game of chess as an amusement, and music as exercise, are more applicable.

Regarding music as an exercise and amusement, it is the most valuable that can be named for the classes just described; and of all kinds of music, the practice of stringed instruments is to be recommended. The vibration communicated in a peculiar way to the brain and nervous system by such instruments, has a great effect on them. We see at once, then, the reason why their use is adapted to those whose constant employment does not so much exhaust the nervous as the muscular system.

If, on the other hand, those who have already made great demands on the nerve-power, addict themselves to much practice of stringed instruments, the result may be too exhausting, and the stomach not keeping pace with the demand for new nerve-material (which can only be supplied by increased efforts of digestion), the organs of the nervous system suffer, and many disorders of the brain are thus induced.

Singing and reading aloud are both very useful as exercises, and are to be recommended, particularly when the state of the weather, or other circumstances, prevent out-of-door pursuits. They promote the activity of the

respiration, which is one of the chief results to be aimed at in exercise of every kind.

We have one remark to make, which we venture to think touches a point to which too little attention has been paid. Amusement is too often recommended to those who have no work, although it is very evident that to all beyond the age of early childhood, all play and no work becomes as dull an affair as its proverbial converse, "all work and no play."

Amusement and work are *relative*, and it is only possible to realize the one by *contrast* with the other. If any one should ask, "What is the best amusement for *me?*" I should reply, "Tell me first what is your work, and then I can answer you;" but if the reply to my question should be, "I have *no work*," then I should say, "You must first find your work, for without this you cannot find your amusement."

There are three problems which I venture to say are among the most important questions of the day, and which I recommend earnestly to my thoughtful readers.

1. How to unite in the same person physical labour and mental employment, and so as to make one relieve the other.

2. To find employments for women in *every* grade of society.

3. To find employment suitable to the insane and the weak-minded, or partially idiotic.

These have all received some attention, and a partial solution; but to realize the *complete* solution of each practically, the concurrent efforts of the most enlightened men among us are yet required.

APPENDIX.

Longevity, and the means of attaining it—*Eye* and *ear*—Their functions—Why not specially treated—What we *should* and what we should *not* do when we begin to feel ill—Quackery, *why* to be avoided — *Summary,* and practical rules — Regimen—Diet—A lesson from the *trainer*—Choice of climate, of avocations, and employments, &c.—Health itself not our ultimate object, but valued for the high purposes to which activity of body and mind may be applied.

THE reader may have been surprised by the omission of topics which appear to demand a large consideration; for instance, nothing has been said on *longevity,* and the art of attaining it.

The explanation, however, is this (and I trust it will be satisfactory), that every page devoted to the inculcation of the laws of health is really applied to the art of prolonging life. It is self-evident that there is, and there can be, no other means of preserving the *continuance* of life than those which insure its healthy *active* exercise. No indolent man was ever known to attain great age. To live *too fast* shortens life, that is obvious; but to live too *slowly* shortens it also, though that is not so obviously true. Activity, toil, even hardship (especially in early life), have been almost constant characteristics of all men distinguished for their longevity.

The books devoted to this subject teem with such instances, and to them I can add that of a very near relative, who, in the public service, endured in early life a large amount of fatigue, exposure to danger, and loss of rest, yet attained to a very advanced age, and with scarcely a day's sickness during his life. He was, how-

ever, temperate; and this is the second constant characteristic of long livers. In short, the rule of longevity is the same as the rule of health. Live, while you live (that is, with activity and energy), and live temperately.

We have also omitted the consideration of the special senses and their organs, as the Eye, Ear, &c.; and our apology is this, that the healthy condition of these organs depends chiefly on the preservation of the general health, especially of *sound nutrition*, of which we have so fully treated.

By far the greater number of disorders of the eye and ear arise from some neglect of the foregoing rules. No doubt the marvellous mechanism of these organs is well worth our study and admiration, and descriptions of them may be found in any cyclopædia or book of general knowledge.

Our space would not admit of doing justice to these subjects without the exclusion of more needful matter.

There is one omission, however, which we will endeavour here to supply, in offering some plain advice to those who may be feeling the approaches of sickness.

What should be done when we begin to feel ill? To make the answer to this question more intelligible, we must distinguish two cases to which it may apply;—1st, one in which a gradual failure of health and strength may be experienced; and 2ndly, another, in which, in a day, or a few days at most, a change of feeling for the worse may occur.

In the first case it is probably some *chronic* disorder which we have to do with, and then we must look well to our ways, and whether we are habitually transgressing the rules of health; and if we do not speedily begin to mend under this self-correction, the best course we can take is to *take advice.*

In the second case, it is probably some *acute* disorder, of more or less gravity, which is hanging over us; and then there are two or three things which we *ought not to do*, though they are frequently done. We ought not to take violent exercise; for this, at the onset of an acute illness, often aggravates it fearfully.

We ought not to take strong aperient medicine, not even the *two antibilious* pills (which almost every medical man, when he first sees a case, finds have been administered); for the very characteristic of some acute disorders —fevers, for instance—is a tender or inflamed condition of the alimentary passages; and much harm may be done by irritating medicine, given, on the approach of such illness, with the view of "*carrying it off*." Alas, very often it is the patient who is carried off by this mistaken raid.

What *should* be done may be shortly stated. Go to bed; obtain complete repose of mind as well as body, as far as possible; take warm, weak drink, as a little gruel, tea, barley-water, &c.; and then, if you do not speedily improve, as before advised, take advice—"And from what quarter?" you will say. Seek,

1st. An *honest* man.

2nd. A man of good sense.

3rd. A man of science.

The first and second are indispensable qualifications, and if you cannot find these, 'twere better to die a natural death or to hope for a natural recovery.

We must in this place give a word of warning against quackery, and for this purpose quote what we have said elsewhere.

"The army of quacks, and that of the regulars in the medical profession, are, of course, natural antagonists, and the public, too easily regarding the conflict between them as one of interest rather than principle, look coolly on, as on a matter in which they are little concerned.

"But *are* the public not concerned in the matter? Undoubtedly they are; for if the quacks make victims, who are they but the public? If money is parted with, not only without any real service rendered or attempted, but, as is the case in many instances, with a positively hurtful result, who are the sufferers but the public?

"The medical profession are, however, not altogether without blame, inasmuch as they too often treat the pretensions of quackery with mere silent contempt, and will

not condescend to explain the grounds on which the objections to them really rest.

"These grounds are tangible enough if once explained, and are so numerous that we cannot pretend to enter into the whole of them in this preface to our little book; but we shall select two of the most prominent, and this, we trust, will be sufficient to open the eyes of the many to the true merits of the question.

"There is this distinction among the quack remedies, so boastingly advertised, that some profess to cure almost everything. Ailments which the medical man knows are of the most various, even opposite nature, are included in a long list which the one kind of pill or potion is to cure.

"These disorders, which are all to be cured by one remedy, are unlike, even in appearance, in many cases; they belong to different families or groups of disease, and differ as much in the place they occupy in the classified system of disease, as a melon differs from a cabbage in the botanical system; and it would be just as reasonable for the horticulturist to adopt or recommend the same culture and treatment in both these cases, as it would be to expect the same remedy to be applicable to so many different complaints.

"But this is not all. There are many instances in which the general aspect of a disease, and even many particular symptoms, so much resemble those of another, that it requires care and caution even in the experienced physician to distinguish the one from the other; and yet the intimate nature of these two diseases may be so different, that the treatment which would be found beneficial in the one case might prove just as injurious in the other.

"What else, then, but mischief can result from the indiscriminate application of the same quack remedy to these very different cases. A mere superficial resemblance, it is plain, can only deceive those who, on the strength of it, adopt a remedy which, in another case, where it has been rightly applied, may have been found useful.

"But there is another class of remedies, which profess only to cure *one* complaint; and surely these must be safe, it will be said,—there *can* be no mistake about them. A little consideration will, however, show that these can scarcely be adopted with more safety than those wholesale remedies which we formerly considered, and this for two reasons.

"In the first place, they are suited only to relieve some one particular symptom, which may arise from many different causes, and that which would be well suited to one cause would not be to another, and, therefore, would not cure; but, in the second place, there are some particular symptoms which, although they are included in the definition of a disease, do not really constitute the evil to be remedied, but must be regarded rather in the light of an effort of nature to get rid of some evil influence; in short, as the substitution of one necessary minor evil for another of major importance.

"Now, in such a case as this, if the quack remedy succeeds ever so well in its so-called cure, that is, in stopping the symptom it professes to relieve, what has it really done but *suppress a salutary effort of nature;* and whether this be desirable, common sense may judge."

Unless, then, you are prepared to submit life and health to a trial of *blind chance*, you will avoid quacks and their medicines; and to facilitate the adoption of a more *reasonable* course, we give here some of the leading deductions from the preceding pages.

SUMMARY, AND PRACTICAL RULES.

When you find a want of vigour, and activity of body or mind, or when you experience depression of spirits, morbid and gloomy imaginations, or perverted feelings, *try to discover the cause*, and whether it be not one dependent on your own acts.

If you are assured, on competent authority, that you

have no organic disease, suspect *bad condition of the blood;* to remedy which, look first to your *diet;* and

As to *quantity*, remember that

Generally, during the period of growth, *deficiency* is to be feared; and,

In adult life, *excess* is the thing to be guarded against.

If your appetite is defective, inquire *why*.

If your avocations are sedentary, see that you get exercise daily, and in the open air if possible.

Cultivate (for it may be cultivated) quietness of mind, and freedom from care and passion; both of which destroy the appetite.

As to the *quality* of your food, remember its twofold object:—

1st. To produce *heat*.

2nd. To repair *waste*.

Refer to the list, page 28, and you will see what *chiefly* serves one, and what the other purpose; but remember, that for *you*, what you can *well* digest is the only proper food.

If you *waste* much, either by muscular or mental exertion, you must repair it by a due proportion of nitrogenous or flesh-producing food; and for those who work chiefly with the brain, the various kinds of pulse, as pease, beans, lentils, &c., are less suited than for those whose labour is chiefly *muscular*.

Consider your habit of body, and also to what disorders you have a tendency, either by hereditary or acquired disposition.

If you are disposed to emaciation, use abundance of farinaceous food, and that containing starch and sugar—especially sound bread (and take the utmost care that it be sound).

If you are disposed to superfluous fat (obesity, as it is called), take the diet just described, but very sparingly; and use more flesh-meat, and rather wine than beer, if you require any stimulant.

If you are disposed to gravel, and it is of the red form, be careful to use little meat and much exercise.

If to the white, or phosphatic kind, moderate exercise,

a more liberal diet, and even wine, with tonics, steel, &c., may be required.

If you are prone to gout, a medium diet is best; but beware especially of fermentible aliments, and of badly-fermented liquors.

If your employment is laborious, pease, beans, cheese, close bread, and fat flesh-meats are suitable; while

Mental pursuits and sedentary habits require rather lighter bread, but a spare use of cheese, pease, beans, a moderate amount of flesh-meat, and, in some cases, a little wine.

When, from want of inclination, you cannot take flesh-meat, or not so much as your waste requires, be careful to substitute those articles *which come nearest to it in quality*, as bread (not too light), *flour* pudding, cheese, pease, beans, cream, and the ordinary fruits and vegetables; but do not depend on starch food, as sago, arrow-root, tapioca, &c. &c., nor on gelatine or jellies of any kind. These may form an occasional addition to, but not the staple of the diet.

As to the times and seasons for taking food—

Avoid long fasting, excessive fatigue, and then taking a full meal in this state. If possible, time it so that, when the stomach and strength begin to require food, you may be able to take it with as little delay as possible.

Dismiss all anxious thought and care when you sit down to a meal; be thankful, and be in charity with all men, as you hope for good digestion.

Eat very slowly, and masticate thoroughly; have recourse to the dentist, if needful, for the means of doing so.

Rest an hour after dinner, if possible; then take moderate exercise, and, so far as your pursuits will admit, make your *chief* exertions of body and mind to fall *between* your meals, leaving a short interval free from all business, both before and after each.

Three meals in the day are sufficient for an adult—the very weak or the diseased excepted.

What should be done when a person suddenly loses consciousness, or is seized with "A FIT," as it is termed?

In every case, all tight ligatures and dress should be loosened, and pure fresh air freely admitted; the case may be either one of APOPLECTIC seizure or of *fainting*. In either case, the sudden and repeated pouring of a jug of cold water over the head and face is good. FAINTING may be *usually* distinguished from apoplexy by the failure of the pulse in the former, and its continued beating in the latter. During fainting, the head should be placed, as nearly as possible, horizontally; but, in an *apoplectic* case, the head and shoulders should be well raised, yet *not* so as to depress the chin on the chest. Of course, medical assistance should be summoned while this is doing.

In cases of *suspended* animation—from breathing noxious gases, or from suffocation, by exclusion of air—the cold affusion, as already advised for fainting, is the best remedy for *first* use.

In cases of DROWNING, apply warmth externally; try to promote movement of the walls of the chest, as in respiration, by turning the body alternately on the side and on the chest, with gentle pressure at regular periods on the back and the ribs. Place the body horizontally, *not* with the feet pulled up and the head hanging down; this would be dangerous. Let fresh air be freely admitted, while warmth is promoted by hot blankets, &c., and frictions.

POISONING.

What should be done (to save time, and *while* medical assistance is sought) in cases of poisoning? We may either know what the poison is, or we may not.

In any case, it is good to procure vomiting instantly, by tickling the throat with a feather, or by an emetic (*sulphate of zinc*—known as white vitriol—a scruple in

warm water, is the best); or a large table-spoonful of *mustard*, mixed with warm water, may be given.

If the poison is known, or from the *stupor*, inferred to be of the *narcotic* class (as opium, morphia, henbane, &c.), or of the *sedative* (as prussic acid, essential oil of almonds, cyanide of potash, &c.), beside the emetic, *cold water*, freely and repeatedly poured over the head is a chief remedy; and, for the prussic acid class, a teaspoonful of hartshorn or spirit of ammonia, in a glass of water, should be given.

For *corrosive sublimate* (bichloride of mercury), give white of egg in large quantity, mixed with water; also wheaten flour, with water.

For arsenic—hydrated oxide of iron (when it can be quickly got); but, in the mean time, repeated doses of *magnesia*, a tablespoonful mixed with water.

For oxalic acid, *chalk* and water, freely and repeatedly: common *whitening*, found in most houses, may be used.

Remember, that in all cases of known, or of suspected poisoning, *no* part of the matter ejected from the stomach should be thrown away; it should be carefully preserved for the examination of the medical man.

CLIMATE—ELECTRIC INFLUENCE, &c.

The subject of climate has, perhaps, been considered too exclusively in one of its aspects,—that relating to *temperature;* but there are many other less obvious, but very important, considerations to be weighed.

It is now well known that the human body is the subject of electric currents; and, as we have already observed, their existence is the necessary result of the chemical changes constantly going on within us. Such changes are also constantly in operation without us, and all around us, both in the mineral and animal kingdom. The earth itself is the subject of magnetic currents; the air is the theatre of electric phenomena, which now and

then are so intense as to attract the attention of all. Lightning we cannot fail to notice; but the constant, silent, unperceived operation of the same force has, perhaps, a far more important influence on our frame; yet it is scarcely recognized.*

As to the choice of particular places of abode in relation to certain predispositions to disease, the following rules may be given:—

All scrofulous or consumptive disorders require pure dry air, but not necessarily hot. It is quite a mistake to suppose that hot climates are favourable to such invalids in all stages of disorder. To some they prove positively

* Magnetism, electricity, chemical agency, are all reciprocal, or at least related forces; and that we are much governed in our state of health, and especially of feeling, by these agents, cannot be doubted. "*Skyey* influences," our great poet called them; but they are *earthly* influences also, as we well know. Little, however, can be definitely stated as to the laws of magnetism in its relation to man, or of that which Baron Reichenbach calls the Odylic force. This subject is closely related to what has been termed Electro-Biology, Mesmerism, Trance and Clairvoyance, Spirit-seeing, Spirit-writing, &c. &c. On these topics we must not even enter at all; we can only leave with our readers two suggestions, to which, we can assure them, we have been led by patient inquiry:—

1st. Do not consider these phenomena as mere imaginations or juggler's tricks; such things really do occur. There *are* more things in heaven and earth than were dreamt of in our (*former*) philosophy.

2nd. Beware how you handle these things—they are not to be trifled with. In estimating the relation of these practices to health—and it is only in this respect that we have a right here to treat of them,—we may do well to inquire whether those who have to do with them, either as operators, media, or subjects, do themselves enjoy sound health of body and mind.

We do not presume to dispute facts asserted by honest men on the one hand, nor on the other to set up our verdict on the moral, social, and religious bearings of the matter, as of the least weight. But we venture to say that all, even the very highest and most mysterious phenomena of mesmerism, electro-biology, and spiritualism, &c., *have occurred spontaneously* (leaving no room for the easy explanation of concerted tricks, &c.), but *always in connection with impaired health.*

To those, then, who seek only practical wisdom, and how to preserve health, bodily and mental, this hint might suffice.

hurtful. Such diseases, it is known, prevail in most large towns in the south of Europe. At the first period of the settlement of our Australian colonies, it was thought we had found a real place of refuge for our consumptives. Experience has in some degree qualified this good opinion; yet the climate of these colonies is still, on the whole, one of the best to which those who are of a consumptive family, and who as yet have only a *tendency* to the disease, can be consigned. The information kindly afforded us by a gentleman* of great experience and long residence in Australia, may be thus summed up. Until within the last few years consumption was almost unknown among the old residents and natives (of the English race), although many cases were imported, as it were; that is, many consumptives arrived in such a stage of the disease that its progress could not be arrested. Of late years, consumptive cases *originating* in the colony have not been wanting. This is attributed to the progress of luxury, and to the increased population *in the towns*. The same distinction holds good in Australia as in England; it is the inhabitants of the large towns who chiefly suffer, and the influence of climate is by no means sufficient to counteract the more potent influence of *habits and modes of life*. A hardy *out-of-door life* is the chief agent in both prevention and cure (during the *early* stage); and the chief advantage of Australia is to afford the opportunity for *more* of *life in the bush* than could be had at home in England.

In most respects, the Australian climate excels that of America, where not only great *extremes* of temperature are to be encountered, but also a wide range of variation within a short time. An American physician estimates this at so much as 40° within a few days. We speak of the northern states only; for we presume few, if any, Englishmen are likely to emigrate to the *southern*, even for the sake of health.

One of the best guides to the choice of climate for

* Dr. George Bennett, of Sydney, New South Wales, distinguished as a naturalist also.

consumptives, is derived from the distinction of this class into *two* divisions,—those who are of relaxed habit and weak digestion, with little liability to inflammatory attacks of the bronchi and lungs; and those who with tolerable digestive powers, show a tendency to these inflammatory states. For the former the Isle of Wight, Clifton, in our own country, *Pau* in the south of France, and *Nice* during winter, may be suited; while for the second, Torquay and Hastings in this country, *Rome and Pisa* in Italy, and Madeira are adapted.

Those affected with chronic *rheumatism* find Nice and even Rome good residences.

In urinary disorders generally, a warm climate is useful, East or West Indies even; and with regard to the alleged unhealthiness of East India, although in that wide expanse of territory there are of course some districts exceedingly unwholesome, from the prevalence of marsh miasma (malaria), as on the estuaries of rivers, low coasts, &c., yet the most experienced residents agree that, with these exceptions, India is not unfavourable to health and longevity for those who go out there *very young*,—say at seventeen, and who will conform their diet, &c. to the requirements of the climate.

Perhaps for those scrofulous or consumptive persons who bear a high temperature well, it may afford the best-known remedy; while others have been found to bear, even with advantage, the bracing air and extreme cold of Canada.

THE SKIN.

Neglect not the care of the skin. Use frequent *warm* baths, soap, friction with Russia duck towels, &c.

Use no hot baths except by medical advice, and cold only if you are robust.

Exercise the limbs as much as possible, and in the open

air when practicable; and use sufficient exercise, at least once a day, to produce sensible perspiration of the skin.

When out-of-door exercise is impracticable, do not omit in-door; not only gymnastics, but reading aloud, singing, music, especially stringed instruments.

Those who are in moderate health, ought to accustom themselves to the open air in almost all weathers.

Use warm clothing, but avoid as much as possible that which is impervious to perspiration.

As to temperature. Let your rooms be kept at a temperature not exceeding 62°, nor falling below 54°.

When you pass from a warm room to the open air in very cold weather, get well heated before you expose yourself.

In passing from a very cold air to the house, go first into the coolest part of the house, so as to avoid the sudden transition from cold to hot air, which is very hurtful.

There is no danger, but much benefit, from the application of cold water to the skin, when the latter is extremely hot; since this is just the condition in which cold affusion is useful, as in fevers.

To promote proper excretion, and to avoid *constipation*, observe the following:—

Let not your diet be too delicate or concentrated; bulk as well as nutrient elements being necessary.

Remember that constipation often depends on the first stage of digestion being imperfect; therefore eat only what you can thoroughly digest.

Do not use aperient medicines if you can possibly regulate the bowels without them. If they become needful, a few grains of rhubarb or minute quantities of castor oil (a teaspoonful only) are to be preferred, especially for the aged, who should avoid saline medicines, or use them very sparingly, as they reduce heat.

As to the excretion of urine. If you find yourself growing fat and weak, and if also you require to pass urine very frequently, suspect disease of kidneys and seek advice, and remember that this disease arises primarily from bad digestion or improper diet.

Never defer attention to the natural call to evacuate the urine, as danger often ensues from this cause.

Take care to keep the lungs in exercise by sufficient locomotion, by muscular exertion of some kind; and also take care that your clothing admit of the free action of the muscles of the trunk, by which respiration is carried on.

Be careful also to avoid all pressure which can obstruct the *circulation* of the blood, especially in *the neck* and in the lower limbs.

Learn a lesson from the *trainer*, for there is perhaps nothing so bad but that some good lesson may be derived from it; and it is a natural and useful inquiry, *by what means* does the *trainer* bring his pupil into fit condition for such a contest as that which has of late attracted so much attention? The rules are these.

1st, and most indispensable of all, is abstinence from strong drink, and from *all* sensual indulgences.

2nd. Continued waste of the old particles of the body, muscular and nervous especially, and of the blood itself, by *strong exercise;* this waste being supplied by

3rd. Plain *solid* diet of brown meats, especially beef and mutton, good bread, &c., a very *sparing* use only of any *liquid* aliments being allowed.

4th. Active frictions of the skin.

5th. Abundant and pure air, with early bed-hours.

We see, therefore, that training is nothing more than *the application of the laws of health* (which throughout this work we have been inculcating) to *their fullest extent.* The only difference, then, which *need* to exist between our ordinary mode of life and a period or *course of training* is this, that in the latter we make health the primary object, and all pursuits of pleasure or business are postponed. This, it may be said, we cannot do in ordinary life. True, we cannot; but, for the most part, the self-denial, industry, and wholesome diet which are the chief features of training, will be no less conducive to success in business and the enjoyment of real pleasure, than they are to the success of the pugilist, pedestrian, or the victor in a boat-race.

To preserve in health the noblest part of man—the brain and nervous system—observe the following:—

Remember that all thought, all sensation, waste the nervous substance.

Do not waste more than your digestive powers can supply.

In pursuing either study or business requiring much thought, take care to *vary* your pursuits as much as possible, that one thing may relieve another.

If possible, choose the early morning instead of the late night.

If you read and write much, have a *standing* desk; do not sit always, and avoid a bent posture.

Do not *habitually* think or read in the recumbent posture: this is a caution of great importance, as determination to the head is much governed by position; on the other hand, in some particular conditions, and on some particular occasions, the recumbent posture is an advantage.

Rossini, it is said, availed himself of it for his greatest musical creations, and George Stephenson used to go to bed for about three days when he had any very difficult engineering problem to solve.

Remember how much the *passions* waste the nervous power.

Do two things with regard to them.

1. Avoid the spur in any form.

2. Use the rein habitually, and avail yourself of the faculty inherent in us, of the concentration of thought in any desired direction by a strong *effort of the will.*

In all lawful things, the question of excess is entirely *relative;* what is moderation for one, may be *excess* for another. Observe *results* faithfully, and the course will be plain.

Finally, as the very purpose for which we value health, and even life, is *activity of body and mind,* so is the well-directed employment of both the essential condition for the preservation of health, for the prolongation of life, and what is more, for rendering this life happy, useful, and preparatory to a higher.

It will be seen that in the preceding pages we have regarded *mind* as a collective term for the faculties of the brain, and we have accordingly considered in its full scope (so far as the narrow limits of our work would admit) "*the influence of the body on the mind.*"*

This view is a very ancient one. In the early philosophy, the faculty of *thought*, and even the testimony of the senses, were regarded as imperfect, *because* dependent on organization,—that is, on *the body*. *Parmenides* (among others) declares that "thought is delusive, because dependent on organization."—(Lewes's "Biographical History of Philosophy.")

At different periods, such a view has been maintained, yet not without much opposition; and it is now in our own day revived, having for its advocates not a few reasonable men. We are aware, however, of the objections which may be brought against it, and that it will be considered by many as bare *materialism*.

How far is such an objection well founded? Our

* Since writing what is above stated, we have read the report (see *Times*, 24th July, 1860) of the trial of Thomas Hopley, for the manslaughter of his pupil Reginald Cancellor. If any proof were required of the necessity of diffusing knowledge as to the relations of body and mind, we have it here in a painful shape. Here we see two intelligent men (for the father sanctioned the method, though not the extent of the treatment), one of them a professor of learning and teaching, blindly endeavouring to cure a disease of the brain by severe beating, when rest and medical treatment were required.

It is in evidence, that the unhappy boy was obstinate and unteachable; that, on examination after death, there was effusion and other tangible proof of disease of the brain. These things stand closely related to each other, it is scarcely too much to say, in the relation of cause and effect; for, as we have maintained throughout our little work, not only our intellectual but our moral faculties are greatly influenced by varying states of the body. Such a truth as this may be abused and false deductions made from it; but it cannot for that be denied; and we have in the miserable instance before us an awful proof of the evil of ignorance on the subject. If such ignorance can prevail among the *learned*, and in a case where the *physical defects* during life, and the proofs of disease found after death, were so obvious, what *can* be expected of the less-learned, and in cases where the true nature of the infirmity is exactly the same, although its indications may be obscure!

reply to this is, that *if* we were to adopt such a view as expressing the *whole* truth respecting man's highest faculties, the objection would be very *well* founded.

Let us take the statement of the dependence of mind on organization, made by an eminent philosopher of the day (J. S. Mill, in his "System of Logic"). He says, "It must by no means be forgotten that the laws of *mind* may be derivative laws, resulting from the laws of animal life, and their truth, therefore, may ultimately depend on physical conditions; and the influence of physiological states or physiological changes, in altering or counteracting the mental successions, is one of the most important departments of psychological study."*

Now, if this statement be taken by itself, it would look like materialism in its objectionable (because *exclusive*) sense; it would seem to be one of those partial expressions of truth, which imply a suppression of the rest (*suppressio veri*). Yet, if we take it as applied only to those functions of the brain which collectively we call mind; and if we *add* to this, that in man, beside the Body and *Soul* (*anima*), or, in relation to this subject, we might say, the *anima*ted brain, there is also the *Spirit, which is not dependent on organization*, which has its own direct way of perceiving, judging, and acting, and reaches the conclusions of reason without the need of reasonings, we shall have the *whole* truth; and, disregarding all mere party clamour, we shall be as much materialists, and as much spiritualists, as the *whole truth* requires us to be.

On this and other subjects, truth has been our aim; our readers will judge how far we have succeeded in finding and expressing it.

* We borrow this quotation from the recently published work of Dr. Laycock, Professor of Medicine in the University of Edinburgh, entitled, "Mind and Brain," which we had no opportunity of seeing until the printing of the foregoing pages was nearly completed. In this work the mutual relations of body and mind are most fully and ably considered, and it will doubtless excite much interest.

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